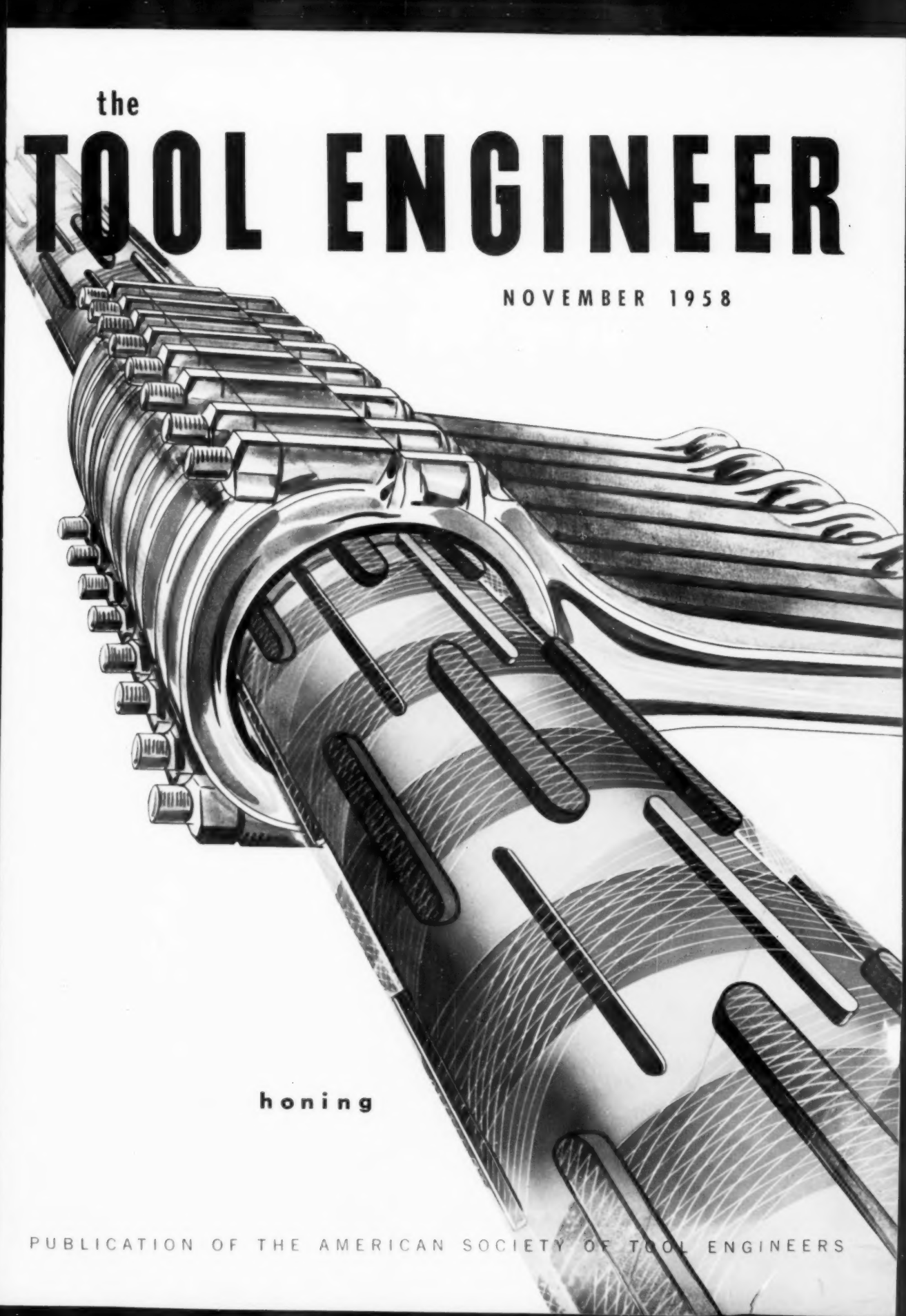
the

TOOL ENGINEER

NOVEMBER 1958



honing

PUBLICATION OF THE AMERICAN SOCIETY OF TOOL ENGINEERS

it's mainly a matter of TIMING!

Knowing WHEN to replace obsolete equipment with a new Heald Bore-Matic saved over $54,000 a year!

A MACHINE doesn't have to be very old in years to be obsolete as far as production costs are concerned. And after all, the purpose of any machine is not just to produce, but to produce at a *profit*.

That's why replacement timing is so important. It depends not only on the age and productive capacity of the old machine—but on a careful cost comparison between the old and the *new*. Such a comparison, in terms of investment and return, will tell you when equipment should be replaced, and when it should be retained.

Our sales engineers are well experienced in making such obsolescence studies—on Borizing and grinding equipment. And they will be glad to do the same for you. Similar studies have pointed the way to many important savings.

For Example: A manufacturer of aircraft control equipment purchased a Heald Model 222 Bore-Matic to replace older equipment for boring, turning, facing and grooving on a wide range of parts. Later, their engineers made a detailed analysis on 12 different parts, to evaluate its cost-saving performance in specific terms. It was found that the machine would save over $54,000 in production costs—not only *paying for itself*, but netting a *profit* of over $29,000 in just the first year! The cost comparison, by groups of parts, is shown below.

	Old Method	New Machine
Annual Prod. Cost—Bodies	$53,004	$14,464
Annual Prod. Cost—Housings	18,124	4,917
Annual Prod. Cost—Carriers	3,276	1,404
Annual Prod. Cost—Plates	1,200	630
Total Cost per Year, all parts	$75,604	$21,415
Annual Saving for New Machine		$54,189
Total Purchase Price		$24,967
Net GAIN in One Year		$29,222

YOU pay for obsolescence. Replacement pays for itself!

THE HEALD MACHINE COMPANY

Subsidiary of The Cincinnati Milling Machine Co.

Worcester 6, Massachusetts

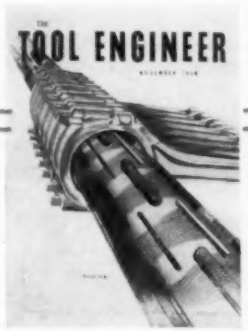
Chicago • Cleveland • Dayton • Detroit • Indianapolis • New York

the tool engineer

Vol. 41, No. 5 November 1958

THIS MONTH'S COVER

Connecting rods are honed in sets to insure that the desired concentricity and straightness are attained and that all rods in a set are uniform. Other ingenious fixturing is covered in the article beginning on page 91. Cover art is, as usual, by William Solms.



THE TOOL ENGINEER is regularly indexed in the *Engineering Index Service* and *Industrial Arts Index*.

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Editorial & Business Offices
10700 Puritan Ave.
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Kindergarten Science

To meet the growing needs of science and to condition the minds of our future scientists and engineers, calculus will be taught in kindergarten. This prediction was made by Col. John P. Taylor, assistant chief of the aircraft laboratory at Wright Air Development Center while discussing the Space Age at a meeting of the Society of Business Magazine Editors.

This seemingly radical proposal is in keeping with accepted concepts for the fantastic future that is beginning to unfold before our eyes. It doesn't take much imagination to accept the unusual after discussing problems of space travel involving gravity, fantastic speeds, and friction.

With scientific knowledge advancing by leaps and bounds, it has become necessary to shorten the gap of understanding between the lay mind and the scientist. Col. Taylor aptly expressed the dangers with a warning: Do not allow degrees of knowledge to differ too far between groups, because communications and understanding could snap and fail like a rubber band that had been stretched too far.

To teach the principles of calculus in kindergarten would involve altering our classical approach to teaching science. Physical concepts and the alphabet are taught with building blocks. Since calculus evolves from the addition of smaller and smaller quantities, the use of building blocks to teach it to the fertile mind seems highly practical. With calculus as a firm foundation, other sciences could also be taught in early years.

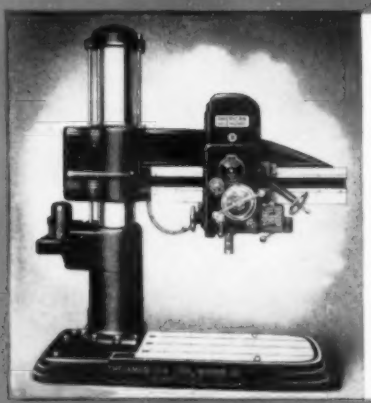
Problems other than those for space are attracting the attention of our planners for the future. In manufacturing, for instance, the master mechanic can no longer be the expert scientist thoroughly familiar with all aspects of production as well as of each and every process or machine in his plant. The science of metal cutting alone is progressing so fast that useful information today is sure to be obsolete tomorrow. The definition: If a machine works, it is obsolete has become an accepted truism.

John W Greve

EDITOR

?

Are you really putting your small radial drills to work...OR... are they just drilling machines



If they are "AMERICAN" Hole Wizards they are DRILLING...TAPPING and BORING MACHINES

...not just radial drills!

To further improve their boring qualities the new "AMERICAN" 9 inch and 11 inch column Hole Wizards now may be equipped with a FINE FEED BORING ATTACHMENT.

This attachment, furnished in addition to the standard feeding mechanism, merely by the flip of a lever reduces the standard feed range 75 per cent.

The fine boring feeds thus provided are the answer to precision boring on radial drills. Many tool and die shops are already using them for high precision, fine finish boring of jigs and fixtures.

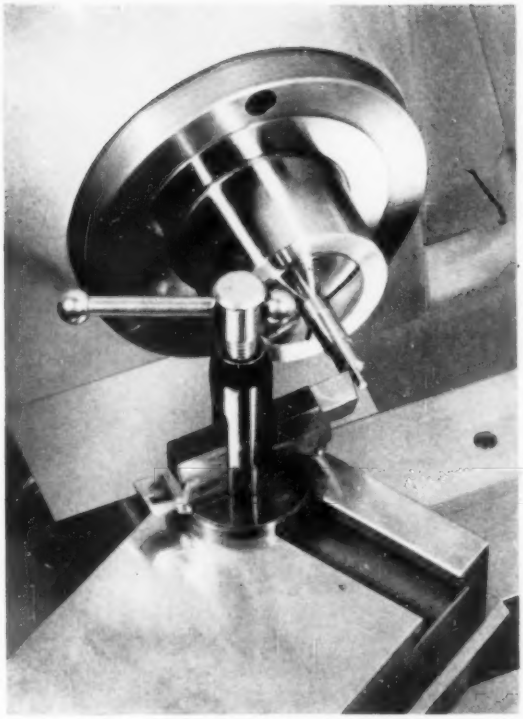
And don't overlook the advantages of the Hole Wizard's Helical Gear—Lo-Hung Spindle Drive —NITRIDED SPINDLE AND SLEEVE—TIMKEN MOUNTED WITH OUTSIDE ADJUSTMENT FOR SPINDLE BEARINGS.

These exclusive "AMERICAN" features permit putting your radial drills to work at a profit.

- ***Ask for bulletin No. 325 and get all the facts.***

THE AMERICAN TOOL WORKS CO. Cincinnati 2, Ohio, U. S. A.

LATHES AND RADIAL DRILLS



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Your production's consistent ...because Card taps are uniform

Your first step in consistent production performance is the cutting tool itself. Because Card machine screw taps are identical they keep production up to par — and predictable. Shopmen know about the uniformity of Card taps. Card gages are like that, too.

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If you use drills as much as rivets are used on airplanes . . .

This brand cuts down your drill usage, production time and costs!

The more you use drills the more you need Union

For best results on your drilling jobs, specify Union drills. Each is top quality. Each lowers your costs and boosts your profits by producing more — and better — holes per drill. Union also manufactures milling cutters, gear cutters, end mills, reamers, hobs, carbide tools and inserted blade cutters. **Available nationally through Union Distributors** and stocked in Union warehouses in Atlanta, Chicago, Detroit, Fort Worth, Los Angeles, New York City and San Francisco.

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(Specific Grade 548 physicals relating to hardness, density, and transverse rupture strength plus microphoto of grain structure available upon request.)

SELECT a throwaway style and size from the form below. Complete the form and request your Purchasing Department to mail it to Adamas. No invoice will be sent to you for 30 days. During this 30 day period . . .

TEST the package of ten Grade 548 inserts you receive against your present steel cutting grade.

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SEND FOR YOUR **548** PACKAGE TODAY!

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DEPT. 271 KENILWORTH, NEW JERSEY

Please enter my order for 10 pieces (one package) of Grade 548 inserts . . . style and size as checked. If at the end of 30 days, for any reason I am not satisfied with their performance I will return all used and unused inserts and my order will be automatically cancelled . . . at no charge.

	BLANK ORDER NO	I.C.	A.	T	R	PRICE	CHECK ONE
TRIANGULAR PRECISION-GROUND NEGATIVE RAKE	TB-12P22	3/8		1/8	1/32	AS PER CURRENT ADAMAS CATALOG	☐
	TB-12P32	3/8		3/16	1/32		☐
	TB-12P33	3/8		3/16	3/64		☐
	TB-16P32	1/2		3/16	1/32		☐
	TB-16P33	1/2		3/16	3/64		☐
SQUARE PRECISION-GROUND NEGATIVE RAKE	SQ-16P22		1/2	1/8	1/32		☐
	SQ-16P32		1/2	3/16	1/32		☐
	SQ-16P33		1/2	3/16	3/64		☐
	SQ-24P32		3/4	3/16	1/32		☐
	SQ-24P33		3/4	3/16	3/64		☐
	SQ-24P34		3/4	3/16	1/16		☐

I would like a style (or size) other than listed above.
Please send me: _____

NAME _____ TITLE _____

COMPANY _____

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No. 124

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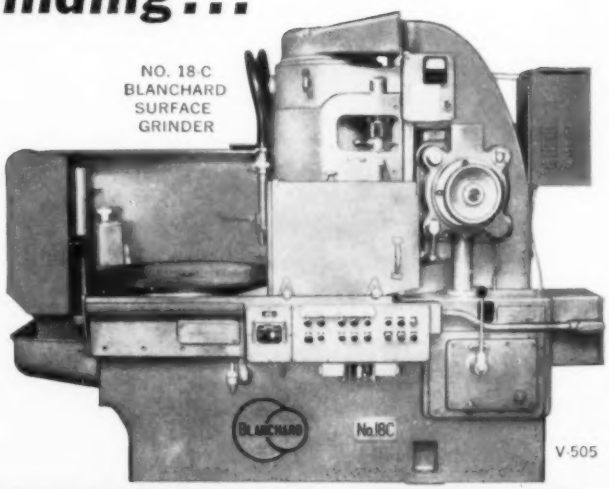
For better, easier grinding...

Whether you're "hogging" off stock from rough castings or precision grinding to a tolerance of ±.0005", you can do it better and easier with the Blanchard No. 18-C Surface Grinder. Once the work is set up, the automatic cycle handles every operation from start to finish. The operator is free to prepare the next load of work or to operate a second No. 18-C Grinder.



Cast Iron Plate. Blanchard ground at the rate of 30 pieces – 60 surfaces – per hour. Stock removal ⅛" each side.

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Hot Rolled Steel Cams. One operator and one No. 18-C Blanchard produce 225 pieces – 450 surfaces – per hour. Stock removal 1/32" each side. Limits ±.001".

just push a button...

- Automatic size control to ±.0005"
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- A large part of operator's time available for
  - (a) Handling or slushing work pieces
  - (b) Filing burrs
  - (c) Selecting correct wheel and preparing for next job
- Specially-designed sizing device with built-in feature to compensate – automatically – for wheel wear during grinding cycle.

All of these features give you *more efficiency at reduced costs!*

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Send for your free copy of Model 18-C folder.

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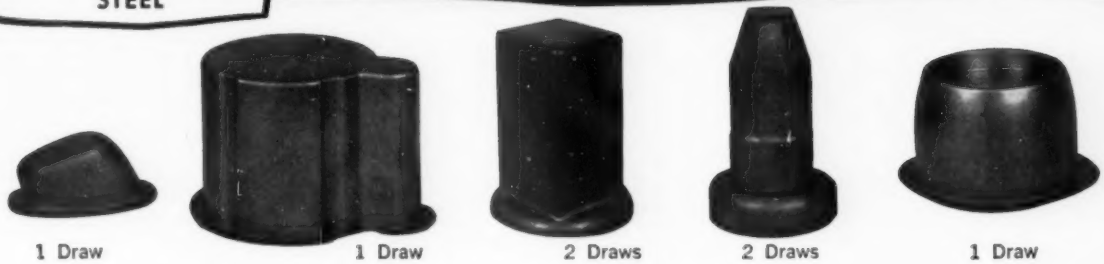
ALUMINUM

2 Draws | 2 Draws | 2 Draws | 2 Draws | 1⅓ Draws

give you fast delivery

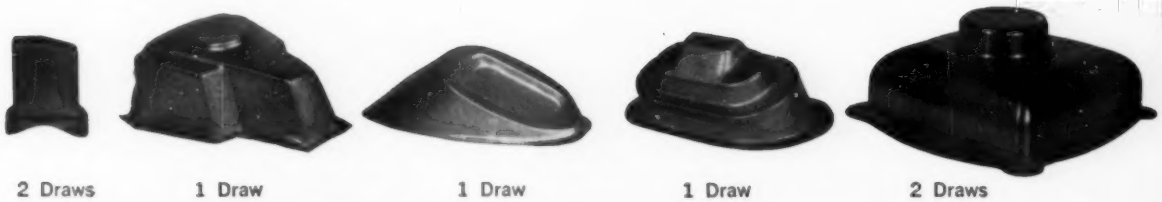
STEEL



1 Draw | 1 Draw | 2 Draws | 2 Draws | 1 Draw

of parts of almost any shape

BRASS



2 Draws | 1 Draw | 1 Draw | 1 Draw | 2 Draws

at savings up to 90% in tool costs

STAINLESS

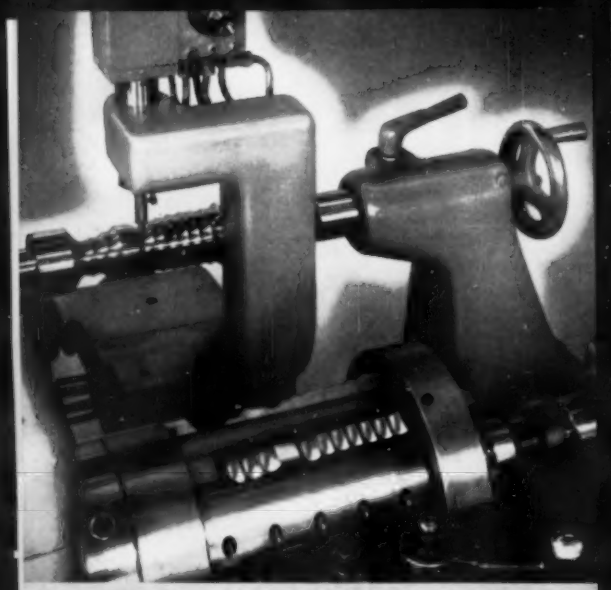
2 Draws | 2 Draws | 1 Draw | 1 Draw | 3 Draws

CINCINNATI Hydroform

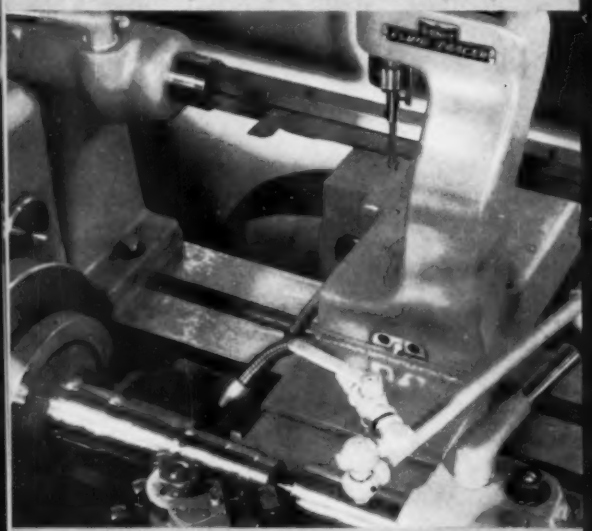
Meta-Dynamics Division

THE CINCINNATI MILLING MACHINE CO.

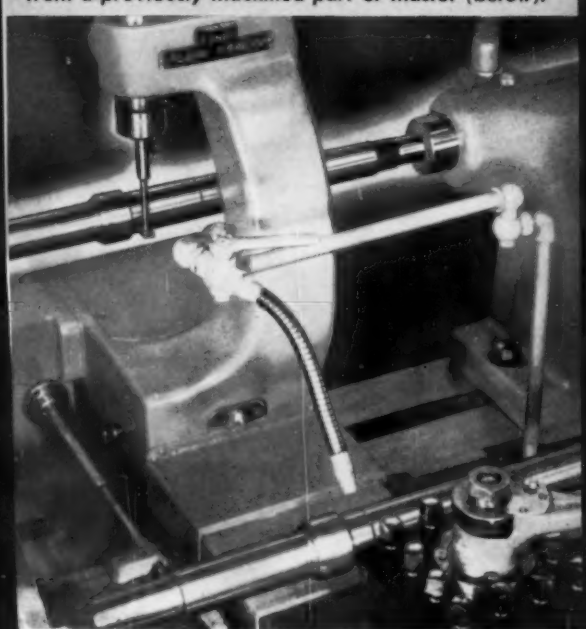
CINCINNATI 9, OHIO, U. S. A.

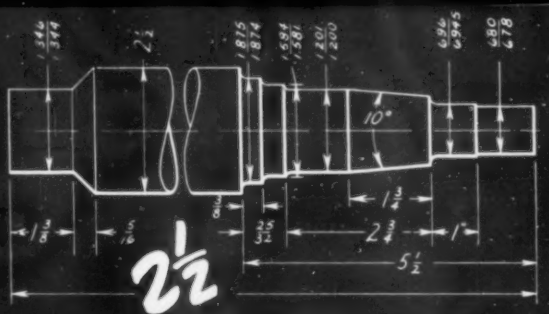


Interrupted cuts don't bother Sidney lathes. Time saved on this job was over 2 hours per piece.



You can tracer-turn from flat templates (above) or from a previously machined part or master (below).





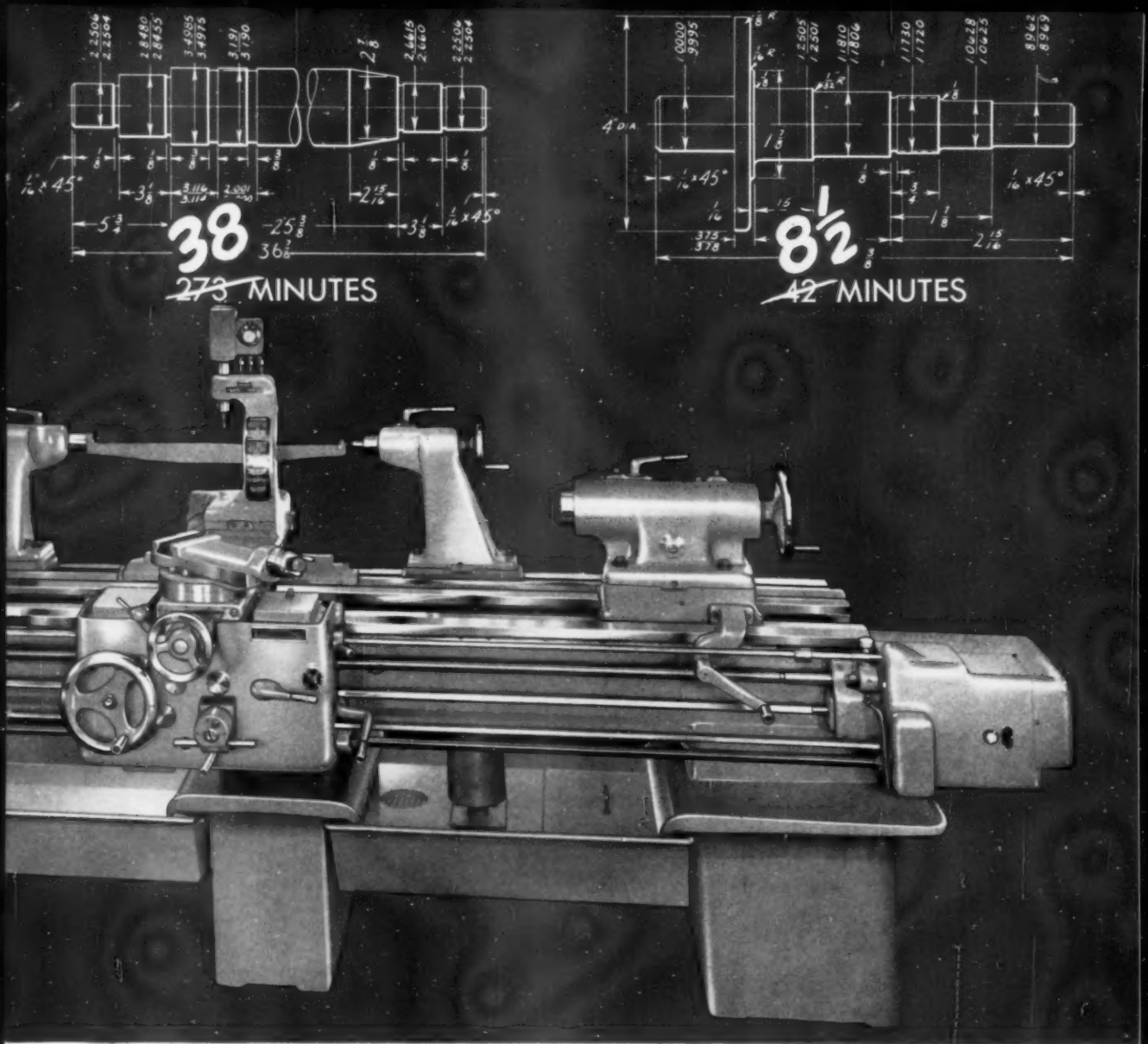
AUTOMATED

You can do both faster, more accurately, on Sidney fluid-tracer lathes using either templates or masters.

Why? Here are some of the reasons:

- **Rugged high-sensitivity tracer head.**
- **Real machine rigidity with exclusive double wall bed.**
- **Exclusive constant mesh herringbone gears throughout the head.**

And remember — Sidney tracer lathes are switched to standard operations in just a few seconds.



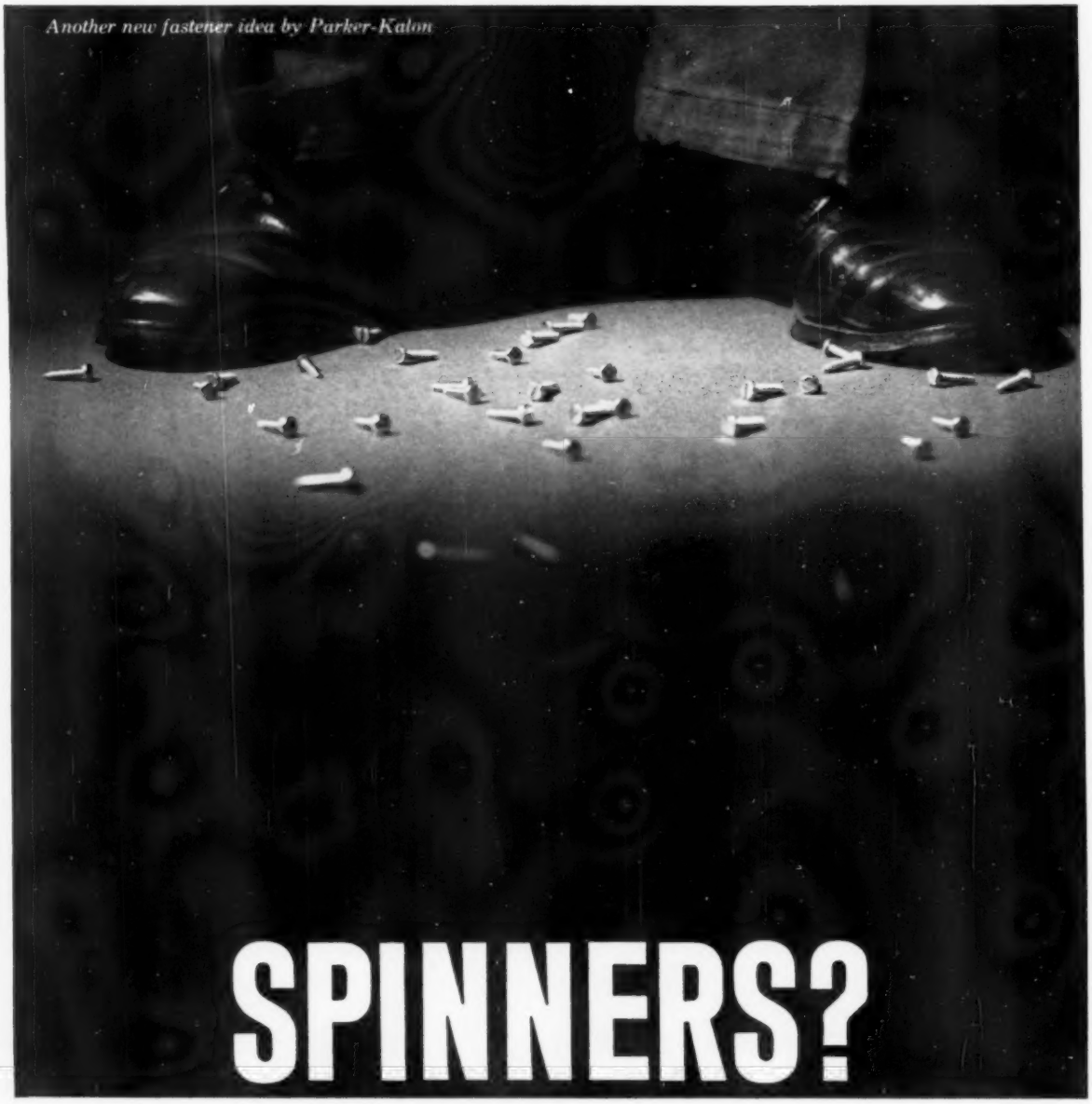
PRECISION DUPLICATING

...of short run or production parts

Ask for "Fluid Tracer" Bulletin

SIDNEY MACHINE TOOL CO.
SIDNEY, OHIO
Wholly owned subsidiary of Buhr Machine Tool Co.

SIDNEY



Screws on the floor mean trouble at your door! Ordinary fasteners when used in the assembly of thin gage metal sheets, often spin or slip—result in work stoppages, salvaging operations, higher production costs.

Now you can substantially reduce waste motion, rejects and lost time, with Parker-Kalon's new "*Hi-thred*" Self-tapping Screw . . . the new fastener that *grips securely without spinning or slipping* . . . even in very thin gage metal sheets.

Developed by P-K's research team, the revolutionary "*Hi-thred*" is THREADED FULL TO THE HEAD—WITH THE LAST THREAD ACTUALLY TERMINATING IN AN ANNULAR ORIFICE IN THE HEAD ITSELF!

For samples, see your nearby Industrial Distributor. "*Hi-thred*" fasteners are available in production quantities *at no increase in price* in Types "A" and "Z" in non-countersunk head styles, in either Slotted or Phillips Recessed Heads.

Keep American Industry at Work! BUY P-K MADE IN U.S.A.

PARKER-KALON® "Hi-thred"

Pat. Pending

Self-tapping Screws

Sold everywhere through leading Industrial Supply Distributors

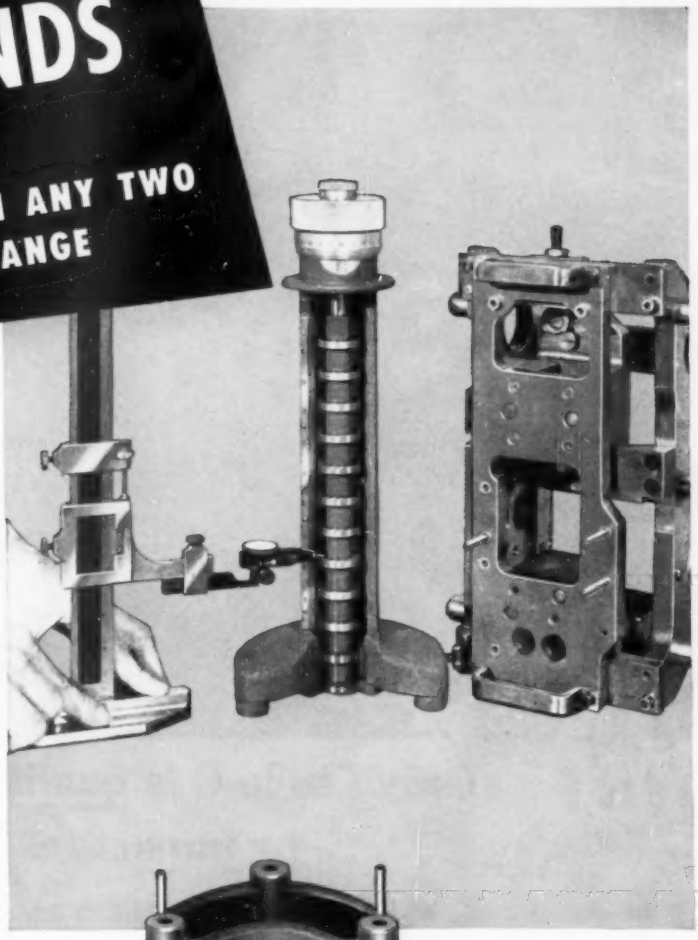
PARKER-KALON DIVISION, *General American Transportation Corporation, Clifton, New Jersey*

SETTING TIME:

10 SECONDS

ACCURACY:

.00005" BETWEEN ANY TWO POINTS IN 12" RANGE



Cadillac PLA-CHEK

SPEEDS ACCURATE INSPECTION from *MINUTES* to *SECONDS*

Designed for easy portability and extreme ruggedness, this 12" Cadillac PLA-CHEK takes little more than 10 seconds to set! Permits surface plate checking and inspections nearly 5 times faster than by ordinary methods.

And, accuracy is assured! Between any 2 points in the 12" range accuracy is guaranteed within .00005".

With a reverse checking plate, a height-gage indicator is easily set for checking the underside of parts. Use of inside micrometers, telescoping and internal cylinder gages gives this gage added versatility. Send coupon TODAY for complete details!

To increase the usefulness of the 12" Cadillac PLA-CHEK Gage, without sacrificing portability, this 6" precision-made riser may be used—upping range to 18".

Cadillac

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Firth Sterling ...

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Only Circle C is quality controlled by impact testing

Every Circle C High Speed tool bit is tested under impact to make sure you get the best bit that can be made. This is the final test in a series of quality control checks made during each stage of production, from Firth Sterling's exclusive double melting process to the finished bit.

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Circle C is one of a family of outstanding high speed steels, including Van Chip, Blue Chip and Star-Mo, accepted throughout industry for reducing machining costs today. All are evidence of Firth Sterling's metallurgical leadership—a background of over 68 years of research and development.

* * *

*For assistance with your metallurgical problems, powder or molten, simply call your nearest Firth Sterling sales office or distributor. For complete information on High Speed tool bits—**and the new Circle C throw away inserts**—write for descriptive bulletin TBI-57:* FIRTH STERLING, INC., Dept. 10L, 3113 Forbes St., Pittsburgh 30, Pa. Offices and warehouses in principal cities.

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PRODUCTS OF Firth Sterling METALLURGY

HIGH SPEED STEELS • TOOL & DIE STEELS • STAINLESS SPECIALTIES • HIGH TEMPERATURE ALLOYS
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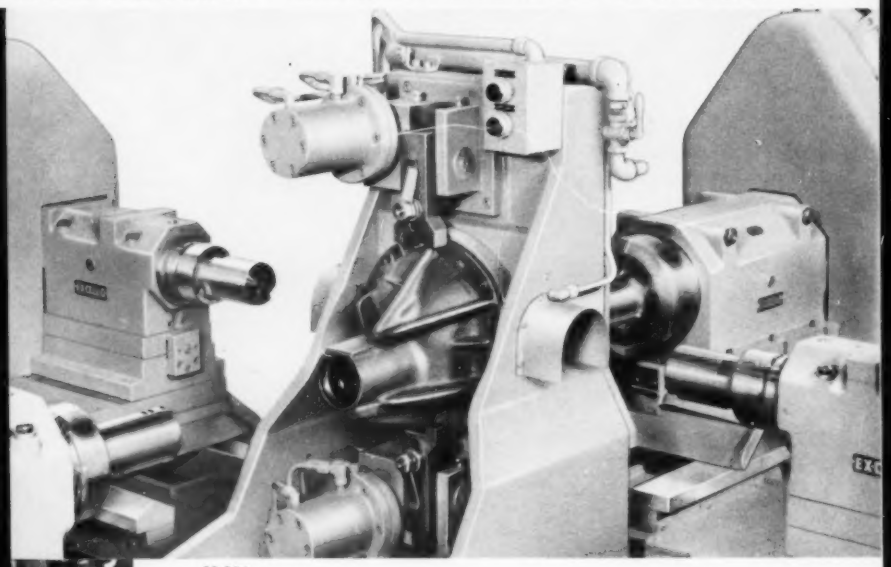
FIRTH STERLING TRADE MARK

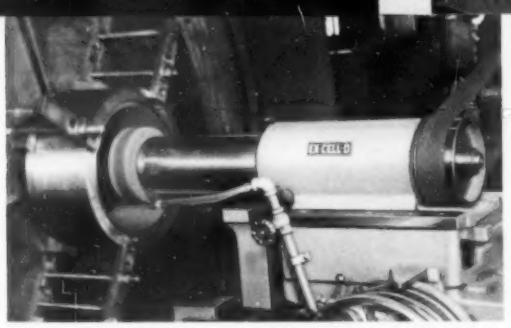
EX-CELL-O Precision Production News

COST-CUTTING IDEAS FROM EX-CELL-O CORPORATION — DEVOTED TO MINIMIZING COST OF PRODUCTION

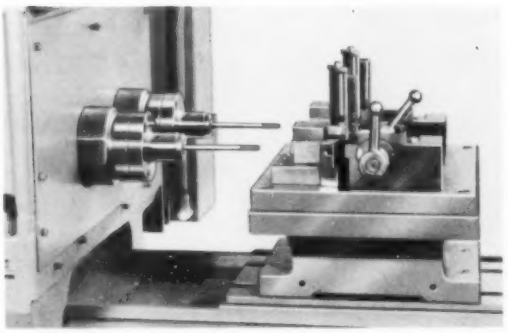


58-32A

Exacting limits are held by Ex-Cell-O Precision Spindles boring pinion bearings and cross hole in this automotive differential carrier. Pre-loaded ball bearing construction of Ex-Cell-O Spindles plus sealed lubrication insure long life and low maintenance.



Internal grinder uses belt-driven spindle to grind 10" I.D. to closest tolerances. Belt-driven Ex-Cell-O Precision Spindles are available in a full range of speeds up to 25,000 rpm.



Two Ex-Cell-O Precision Spindles are used in this Bor-Drilling setup to drill jet engine blades with extreme accuracy. Ex-Cell-O Spindles hold critical limits in either ferrous or non-ferrous metals.

Do More Jobs— More Accurately

Standard Ex-Cell-O Precision Boring and Grinding Spindles cut costs in precision production

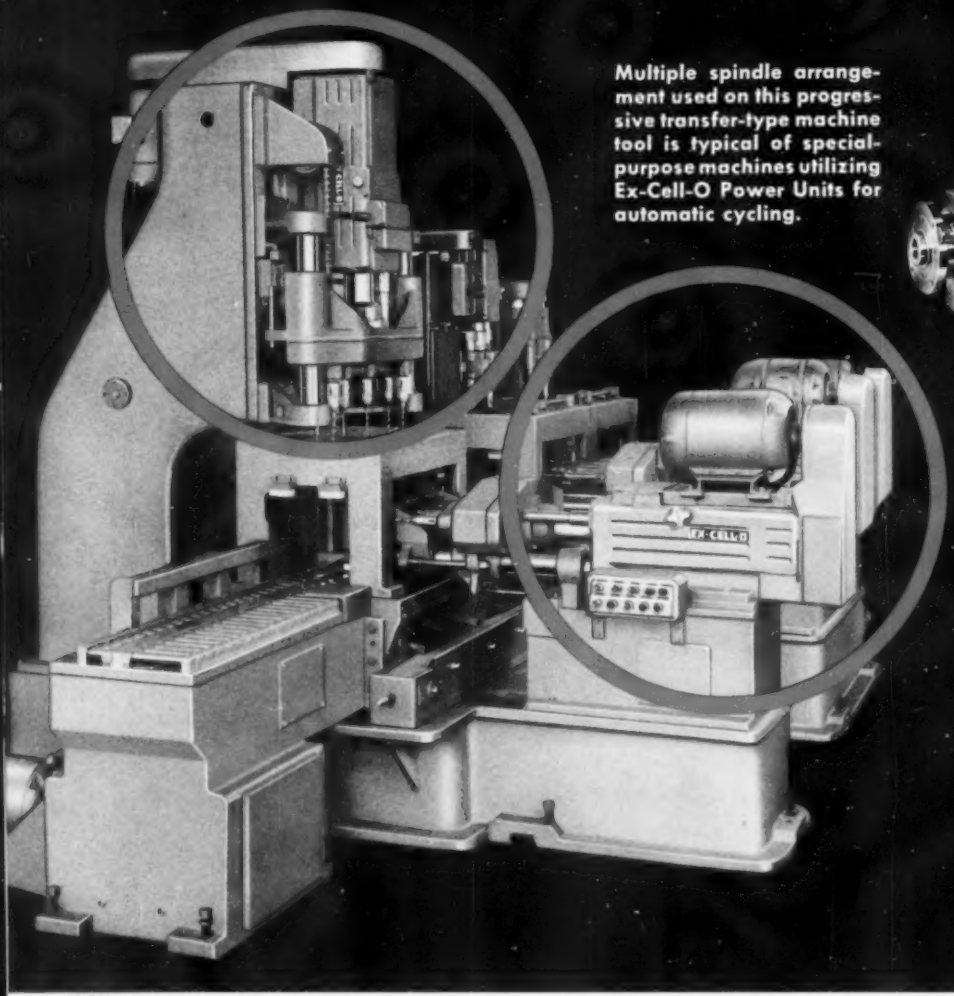
Installed as original equipment or as replacement components, standard Ex-Cell-O Precision Spindles put job-engineered efficiency into every job—surface grinding, I.D. grinding, precision boring and other applications.

Whatever the type—belt driven, air driven or motorized, designed for standard current or high frequency applications—Ex-Cell-O Spindles have earned an enviable reputation throughout the world for precision and versatility, for long-lasting operation, and for production savings.

Pre-loaded ball bearing construction, absence of vibration and chatter and low maintenance make Ex-Cell-O Spindles first choice for close-tolerance, fine-finish work. Spindles also are available with heavy duty bearings for roughing and semifinishing operations.

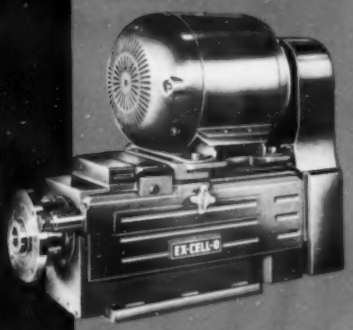
Your local Ex-Cell-O Representative can give you all the details, or write direct.

3 MORE COST-CUTTING IDEAS



Multiple spindle arrangement used on this progressive transfer-type machine tool is typical of special-purpose machines utilizing Ex-Cell-O Power Units for automatic cycling.

58-328



STYLE 28-A HYDRAULIC POWER UNIT

STYLE 22 QUILL-TYPE HYDRAULIC POWER UNIT

STYLE 20 HYDRAULIC POWER UNIT

POWER

for Changing Production Needs

EX-CELL-O QUILL-TYPE HYDRAULIC POWER UNITS CAN BE USED OVER AND OVER AGAIN, PUTTING POWER WHERE YOU NEED IT, WHEN YOU NEED IT

Ex-Cell-O Hydraulic Power Units lower manufacturing costs even on short and medium runs by performing a variety of jobs—adapting quickly to your changing production requirements.

Used to actuate single tools or multiple spindle heads for drilling, counterboring, facing, reaming and other operations, they are designed as a compact "power package" to permit close center distances when used in-line or when rearranged and positioned radially around a fixture.

Suited to many applications, including special machines with automatic cycling, Ex-Cell-O Power Units are self-lubricated, easily installed, and they're built with famous Ex-Cell-O precision for trouble-free, long-lasting service.

Call your local Ex-Cell-O Representative or write Ex-Cell-O, Detroit, for details on the full line of Hydraulic Power Units.

This is cost-cutting— with CTW Carbide Broaches

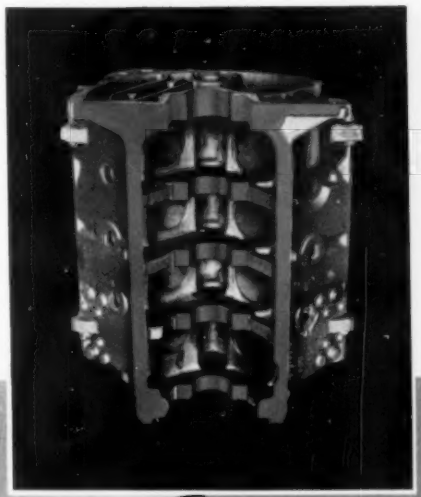
Continental Broaches increase output and reduce downtime in automobile engine block production

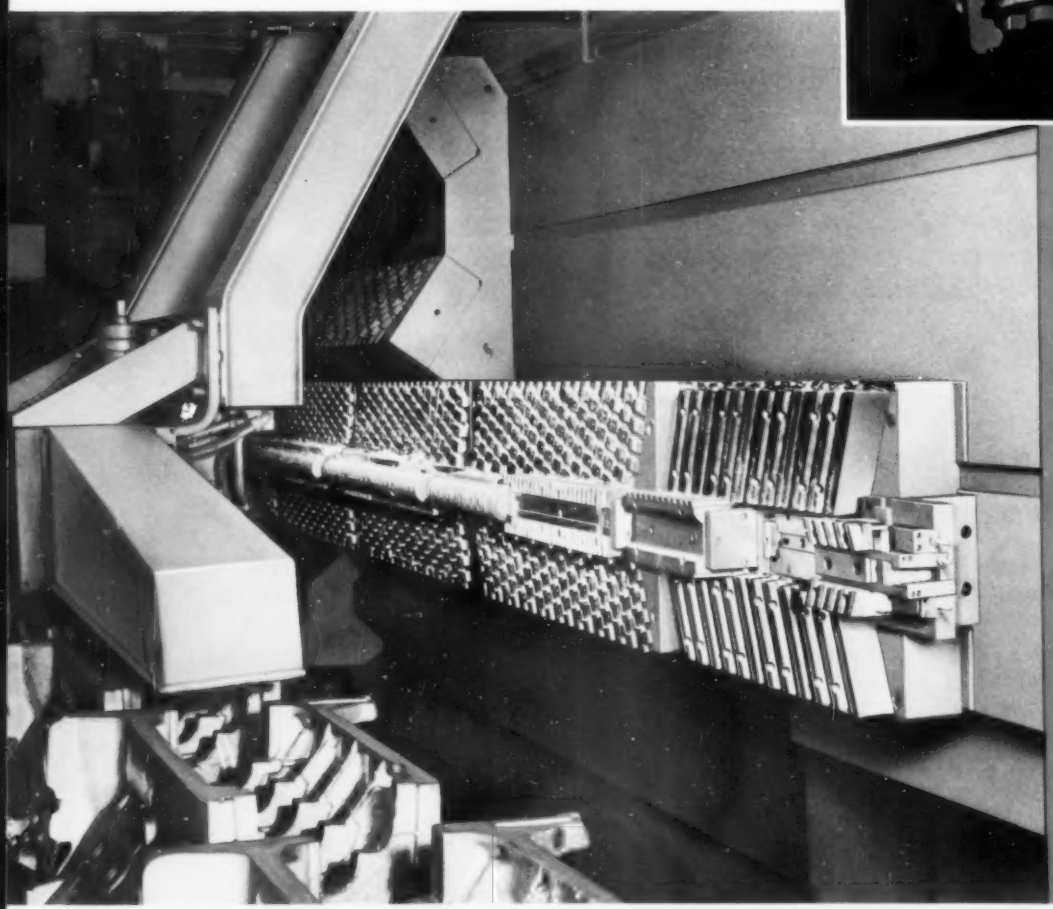
Greater production with less downtime are just two of the important reasons why a large automobile manufacturer uses Continental tooling for broaching of pan rail, half bores, bearing locks and parting faces of V-8 engine blocks.

Removing a maximum 3/16" stock in a single pass, this five-section, combination half-round and face broach uses carbide-tipped tool bits and broach inserts to semifinish and finish 20,000 to 22,000 cast-iron blocks between tool resharpening.

This automotive operation proves again why the production savings made possible by Continental tooling makes the "best cost less" than ordinary broaches.

58-32C





Above: In a single pass, multiple surfaces of this cast-iron engine block are semifinished and finished. Maximum stock removal is 3/16".

Left: Continental Broaches used in this horizontal surface broach machine are made up of five sections combining half-round and facing broaches. Tool bits and broach inserts are 100% carbide-tipped.

CONTINENTAL TOOL WORKS division of EX-CELL-O CORPORATION

EX-CELL-O PRECISION PRODUCTION NEWS

58-32D

Make the scrap-pile test!

Start using Ex-Cell-O Drill Jig Bushings today—then watch how worn-out bushings disappear from your scrap-pile!

The reason is simple: Ex-Cell-O Drill Jig Bushings last longer because they're made better!

The answer lies in the chrome-alloy bearing steel used in Ex-Cell-O Bushings; in up-to-date automatic heat treating methods; in hole hardness quality-controlled to uniform 62-64 Rockwell "C"; and in Ex-Cell-O's own high standards for precision-ground finish inside, outside and under the head for perfect seating.

All this—plus immediate delivery to your plant from the large Drill Jig Bushing inventories Ex-Cell-O maintains at key points throughout the country.

You get fast service on special sizes, too, because Ex-Cell-O stocks many semifinished bushings in addition to the more than 10,000 standard sizes always on hand.

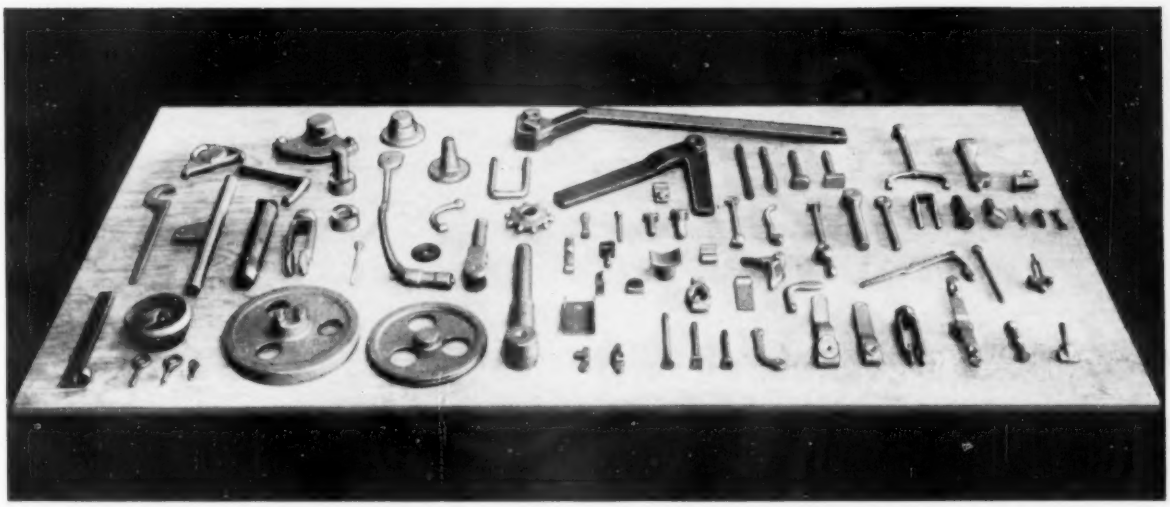
For "same-day" shipment, order from Ex-Cell-O Corporation at Detroit, New York, Cincinnati, Downey, Calif., or London, Canada. Call your local Ex-Cell-O Representative or write direct for an Ex-Cell-O Drill Jig Bushing catalog today.

EX-CELL-O
CORPORATION
DETROIT 32, MICHIGAN

MANUFACTURERS OF PRECISION MACHINE TOOLS • GRINDING AND BORING SPINDLES CUTTING TOOLS • TORQUE ACTUATORS RAILROAD PINS AND BUSHINGS • DRILL JIG BUSHINGS • AIRCRAFT AND MISCELLANEOUS PRODUCTION PARTS • DAIRY EQUIPMENT

XLO
EX-CELL-O FOR PRECISION

200 Different Parts Heated for Forging - Better, Faster and at Much Lower Cost with TOCCO* Induction Heating



• When progressive production people at General Railway Signal Company installed a 200 kw, 3000 cycle TOCCO machine, they were able to eliminate 7 slot-type oil-fired furnaces and produce better forging than ever before—at substantially lower costs.

Cost Down—Fuel costs have been reduced from $15.26 to $1.60 per hour with TOCCO. Expensive furnace lining maintenance has been eliminated, and straightening and reheating operations formerly required are no longer necessary.

With oil-fired furnaces all steam hammer operators needed helpers. With TOCCO most of these helper operations have been eliminated.

TOCCO's fast, automatic operation produces almost no scale and achieves uniform temperatures throughout the entire cross section—improving the quality of the forgings and providing increases of up to 400% in the life of the forging dies.

Overall production costs in the forge shop at G.R.S. have been reduced an impressive 35%!

Flexibility—Production runs at G.R.S. range from a low of 15 pieces to a high of over 50,000. Parts from ½ pound to over 25 pounds are heated, merely by changing inductor coils and power control settings.

Better Working Conditions—TOCCO makes the forge shop a better place to work by doing away with noise, dust, dirt, smoke and radiant heat and gases produced by old fashioned furnaces.

If you're looking for a way to produce similar results in your plant, it will pay you to consult a TOCCO Engineer.

TOCCO

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Please send copy of "Typical Results of TOCCO Induction Heating for Forming and Forging".

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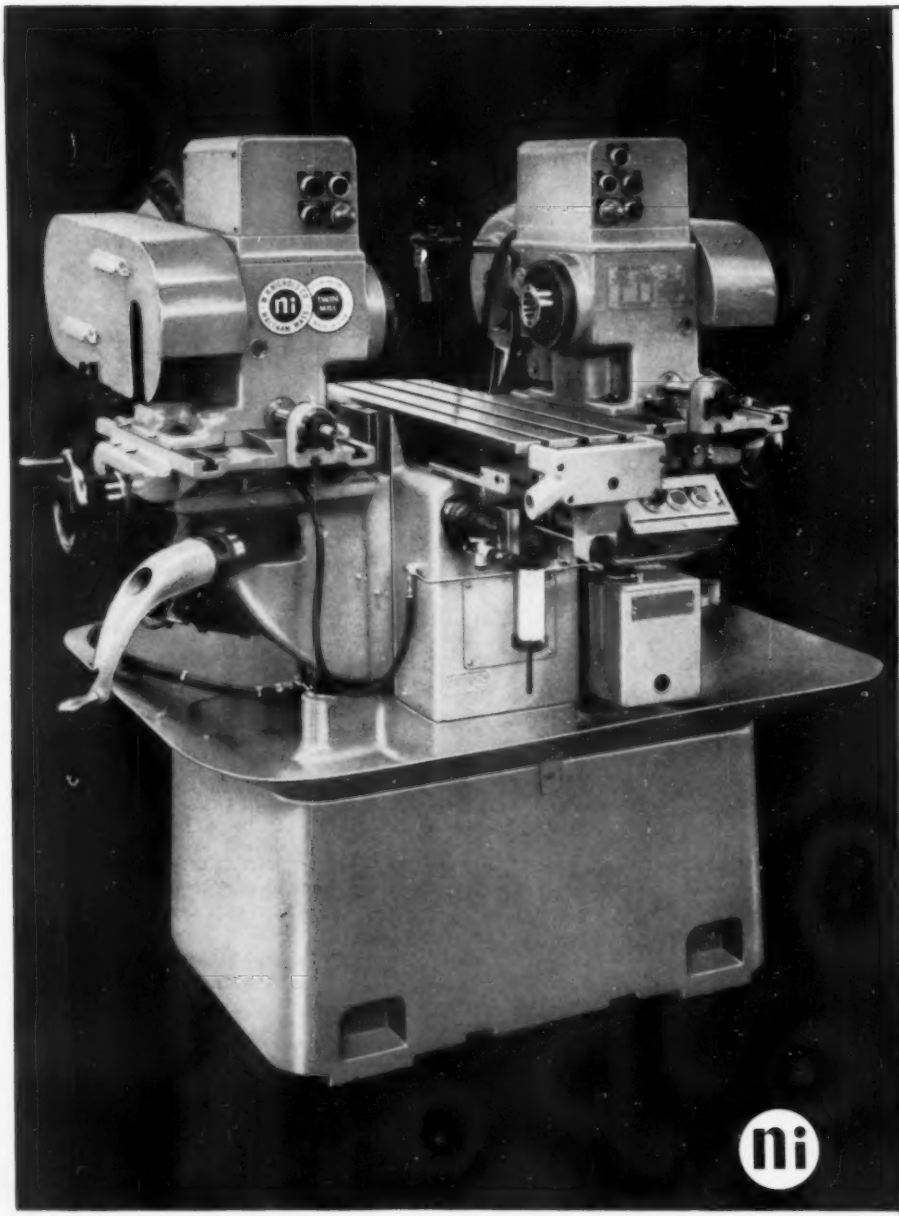
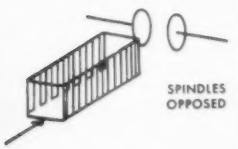
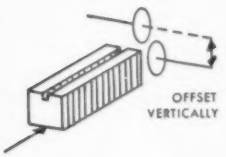
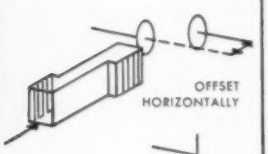
NICHOLS TWIN MILL FOR THE GREATEST VERSATILITY PER DOLLAR

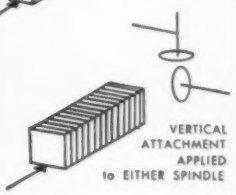


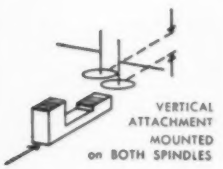
ALL THESE OPERATIONS











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Tool Steel Topics

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation

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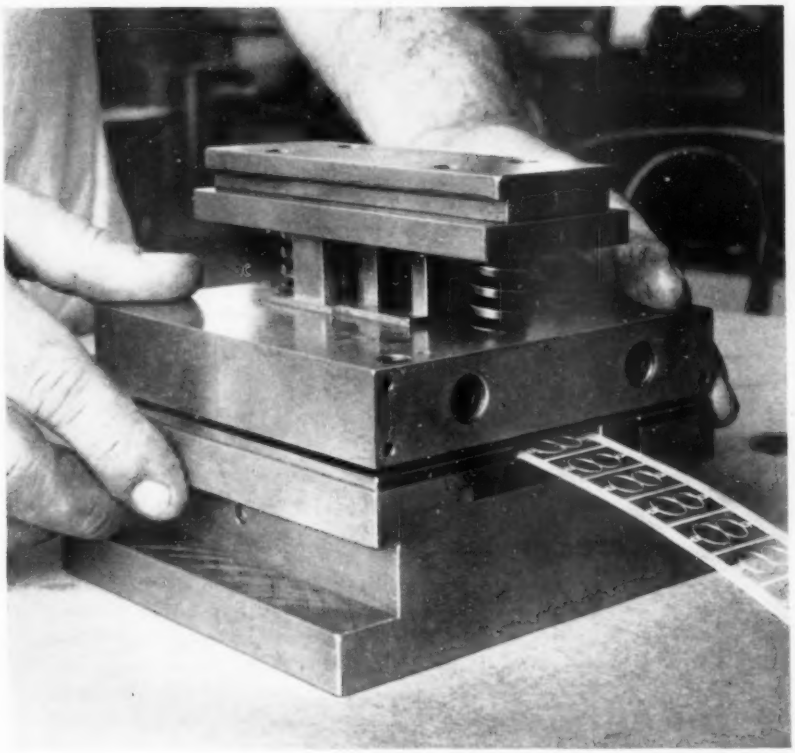


Die of Lehigh H Stamps Delicate Digits

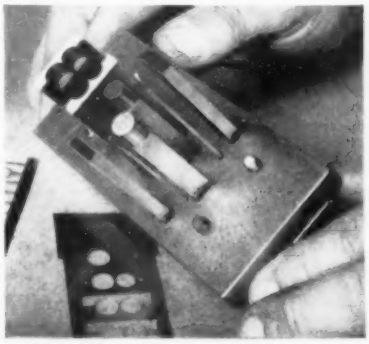
The slim, digit-shaped stampings shown above are anodes, one of a series from 0 to 9, for a numerical indicator tube used in an electronic computer. They are made from several different metals. The width of the anode varies with each digit, and some are as narrow as 0.007 in.

Because of the extremely small clearances involved, the die maker, Be Cu Mfg. Co., Newark, N. J., decided to use progressive dies of a type previously used in producing sub-miniature parts. The dies were made from Bethlehem Lehigh H, supplied by our local tool steel distributor, Lindquist Steels, Inc., Elizabeth, N. J. And because of its low distortional characteristics, Lehigh H proved to be a wise choice.

TYPICAL ANALYSIS

Carbon 1.55	Chromium 11.50
Manganese 0.40	Vanadium 0.90
Molybdenum 0.80	

Lehigh H is our high-carbon, high-chrome grade of air-hardening tool steel. Outstanding because of its minimum size change during heat-treatment, it has the high wear-resistance needed for long-run jobs. Your Bethlehem tool steel distributor has it in stock. Give him a call today.



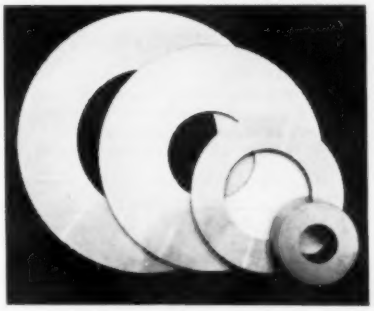
BETHLEHEM TOOL STEEL ENGINEER SAYS:

Heat-Treatment Is SO Important

Investigations of tool failures have shown that improper heat-treatment is responsible for a large proportion of the troubles. Adequate heat-treating equipment is often unavailable, or the equipment is operated improperly.

The importance of proper heat-treatment is often overlooked because it is relatively inexpensive as compared with the cost of the steel and the machining operations. However, just as the links in a chain must be equally strong, the heat-treatment operations on tools must be given proper consideration.

Whenever there is any doubt as to the adequacy of available equipment or its operation, it pays to look for help elsewhere. Commercial heat-treating shops, which are located in every section of the country, have the equipment, the ability, and above all, the experience to handle the heat-treatment of tools.



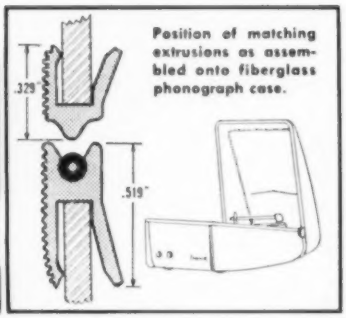
HOLLOW-BAR MINIMIZES MACHINING COSTS

Yes, you get greater economy in the shop, and a saving in material as well, when you use Bethlehem Hollow-Bar tool steel for any part requiring a center hole in the steel. We make Hollow Bar by high-speed trepanning, which means coring out hammer-forged or hot-rolled bars, then rough-turning them on the outside. You can put the steel right to work, because the hole is already there. Two grades to choose from: BTR (Bethlehem Tool Room, oil hardening), and Lehigh H (high carbon, high chrome).

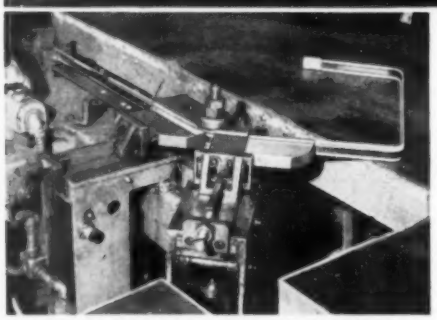
800 Bends An Hour

IN ANODIZED EXTRUSIONS ON PINES MODEL ¾ BENDING MACHINE

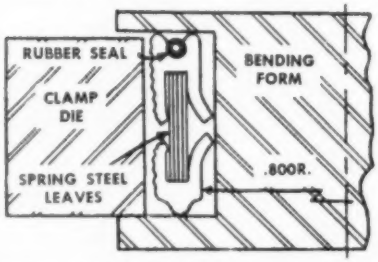
View of 12-year-old Pines Model ¾ Bending Machine at Kinkead Industries Incorporated, Chicago, bending decorative aluminum extrusion closure strips.



Position of matching extrusions as assembled onto fiberglass phonograph case.



Close-up showing tooling employed in bending two matching extrusions simultaneously. Black strip separating two extrusions is spring-steel mandrel used to prevent collapse of open sections during bending.



Extrusions are positioned in tools as illustrated above. Die surfaces are nylon coated to prevent scratching the anodized finish. Rubber seal is installed in straight lengths before bending.

How Accurate Bending Simplifies Fitting of Scratch-Free, Matching Closures on Phonograph Cases

A unique tooling setup on a Pines Model ¾ Bending Machine enabled Kinkead Industries Incorporated, of Chicago, to fill an order for accurate 90° bends in matching aluminum extrusions. Bends are made simultaneously in a pair of extrusions at net production averages of 800 bends, or 100 pair of frames, per hour. Accurate forming simplifies corner fitting and assembly of the completed pieces used as closure strips on phonograph cases. As illustrated, the two extrusions are mounted on spring-steel strips which serve as an internal mandrel and prevent collapse of the sections in the bend area. Bending the two strips simultaneously assures perfect mating when assembled onto the fiberglass cases.

Ends Meet in Butt-Fit Without Trimming

Before bending, both of the extruded shapes are anodized to a beautiful, bright finish. Die surfaces are faced with nylon to protect the decorative finish and prevent marring during the bending operation. No lubrication is required. The uniform accuracy of the bending operation also eliminates any need for trimming the pre-cut stock. The ends meet in a butt-fit. Kinkead's fine line of stainless steel and aluminum products, known as "Kintrim," is another example of the quality bending results that have long been achieved on Pines Benders. Look to Pines for the practical solution to *your* bending problems.

PINES ENGINEERING CO., INC.

Specialists in Tube Fabricating Machinery

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WRITE FOR FREE CASE STUDIES

For case study reports on the cost-cutting advantages of cold forming the "Pines-Way," write for free copies of Pines News. For analysis on any job, ask a Pines representative to call.

PRODUCTION BENDING • DEBURRING • CHAMFERING MACHINERY

TEST after TEST

proves the economy of using CLE◇FORGE SPECIAL PURPOSE DRILLS

Time after time CLE-FORGE Special Purpose Drills have clearly demonstrated their ability to produce *more holes* at *lower cost,* as proved by hundreds of actual tests in customers' plants. Typical records show that CLE-FORGE Special Purpose Drills . . .

. . . produce 10 times more holes per grind . . . increase production 80% . . . double the number of holes per grind . . . cut cost per hole . . . eliminate breakage . . . speed production at no increase in tool cost . . . average 13,000 more holes per grind.

These are not "special" tools, but are stock drills at regular prices . . . available for immediate delivery.

For greatest economy, CLE-FORGE Special Purpose Drills can be ordered with tangs (at no extra cost) and used with CLEVELAND Split Sleeves. Instead of paying for a taper shank on every drill, you get the needed length with a CLEVELAND Split Sleeve—which outlasts many drills.

If you have a problem of high drilling costs, perhaps a CLEVELAND Service Representative can help you solve it with CLE-FORGE Special Purpose Drills. Contact our nearest Stockroom, or . . .

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THE CLEVELAND TWIST DRILL CO.

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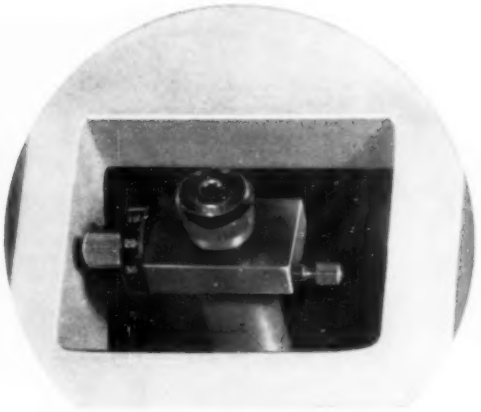
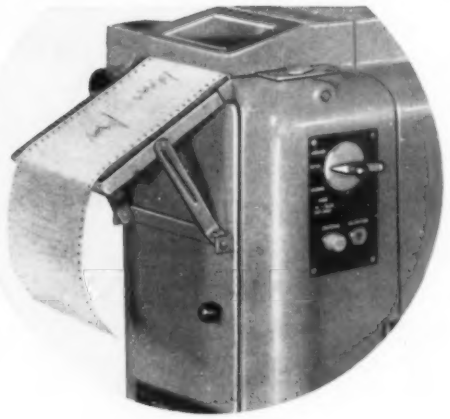
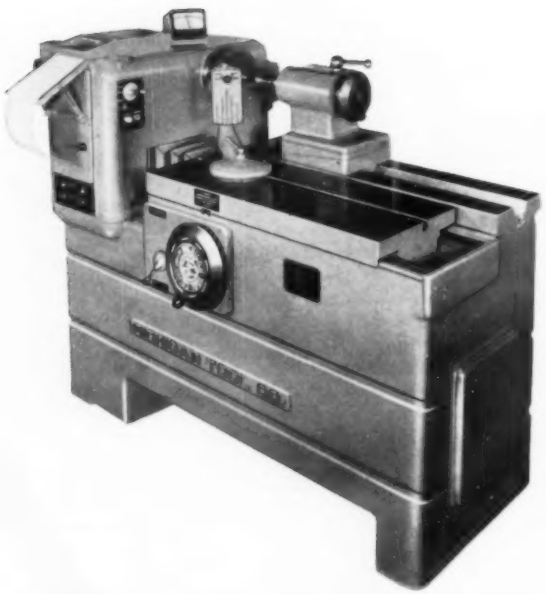
A 56x macroscope with graduated eyepiece (image appears right side up and unreversed) provides the precision reference against which the sine-bar plate (controlling table movement) is located. No special operating skill is required.



Now- an EASY way to check gear lead

Michigan's new Precision Lead-Measuring Instrument uses built-in optical system, recording device to simplify setup, assure accuracy





Bulletin 1218A details the unit. Send for it.

Cuts your set-up time 25 to 50% . . . calculations are virtually eliminated . . . checks leads from zero to infinity to tenths on external and internal helical and spur gears. Also checks herringbones and worms. Instead of gage blocks, micrometers, verniers, etc., you merely line up cross-hairs through a direct-reading, built-in optical system. The sine-bar controlled instrument is manually operated . . . exact-angle locking is positive. Now, you're checking gear leads—fast, accurately and economically. Other 1218A features: an integral data recorder for permanent reference; an electronic gaging head; capacity to 18-inches gear diameter; and Michigan Tool construction.

MICHIGAN TOOL Company

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ANNOUNCING

the cylinder you designed!

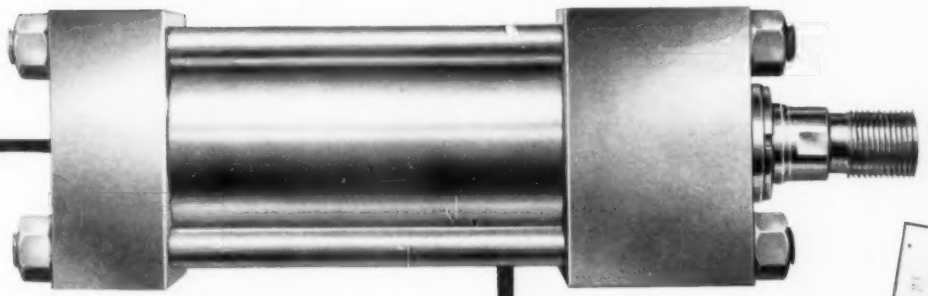
To save you and hundreds of other busy engineers time at the drawing board, Hanna representatives asked what you desired in hydraulic cylinder design.

You wanted a **stronger cylinder, preferably all steel with welded mountings.** You also wanted **tight sealing** at all pressures. These features were included in the Hanna Powrdraulic design. Some wanted **automotive piston rings;** others wanted **synthetic piston packings,** so the new flexible Powrdraulic design gives you a choice. You can also choose the **fast change cartridge gland** or the conventional **multiple lip packing** and you have a **choice of packing material** including Teflon* and silicone rubber.

Hydraulic cylinders should incorporate **industry standard mounting dimensions** and conform to Joint Industry Conference recommendations. These are included in the Powrdraulic design.

In addition, you want a cylinder that is **priced right,** with **prompt delivery** and **service available** in all parts of the country. You can have all this plus the assurance of quality when you specify Hanna Powrdraulic cylinders.

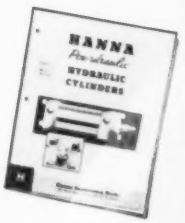
We will be happy to send you a catalog, and give you the name of your nearest Hanna Representative. You'll also find him listed in the yellow pages under "Cylinders" and in the alphabetical section of Thomas' Register.



Hanna Powrdraulic Hydraulic Cylinder
2000 psi and 3000 psi non shock — with generous factor of safety

Featuring — Pressure tightening tube seals
• One piece steel heads with welded mountings
• Double seal piston rings • Fast change cartridge gland
• Lubricated rod bearing

For full details write for Catalog 900



* Teflon is DuPont's registered trademark for its fluorocarbon resins.

Hanna Engineering Works

HYDRAULIC & PNEUMATIC EQUIPMENT • CYLINDERS • VALVES

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3M Chemicals opening new worlds of use for stamped metal

Now . . . stamp metal parts with resin dies!

New 3M Brand compound saves 50% to 90% in tooling costs

Now, you can actually stamp metal parts, such as those above, with resin dies! From Minnesota Mining and Manufacturing Company comes 3M Brand Tooling Compound 113.

It's a new, two-part tooling compound that combines catalyst-treated steel powder and liquid resin to form low-cost dies that have exceptional impact strength and can operate in presses up to 85 tons. What's more, dies made of Tooling Compound 113 perform at the same production rates and efficiency as do dies made of steel.

In addition, new Tooling Compound 113 eliminates the bugaboos of weighing, mixing, pot-life and toxicity common to conventional tooling compounds. Preforms are fabricated from the treated steel powder; then placed in a pan containing liquid resin for impregnation and curing.

Simpler handling, faster drying and curing achieved with Tooling Compound 113 saves time and materials to cut tooling costs by 50% to 90%, compared to those of ordinary methods.

3M Brand Tooling Compound 113 is ideal for short runs—in the thousands—for punch-and-die operations. Investigate these profit-saving benefits now. For full data, write: *3M Company, Dept. WS 38, St. Paul 6, Minnesota.*

Hastings Chemical Division • Chemical Products Group

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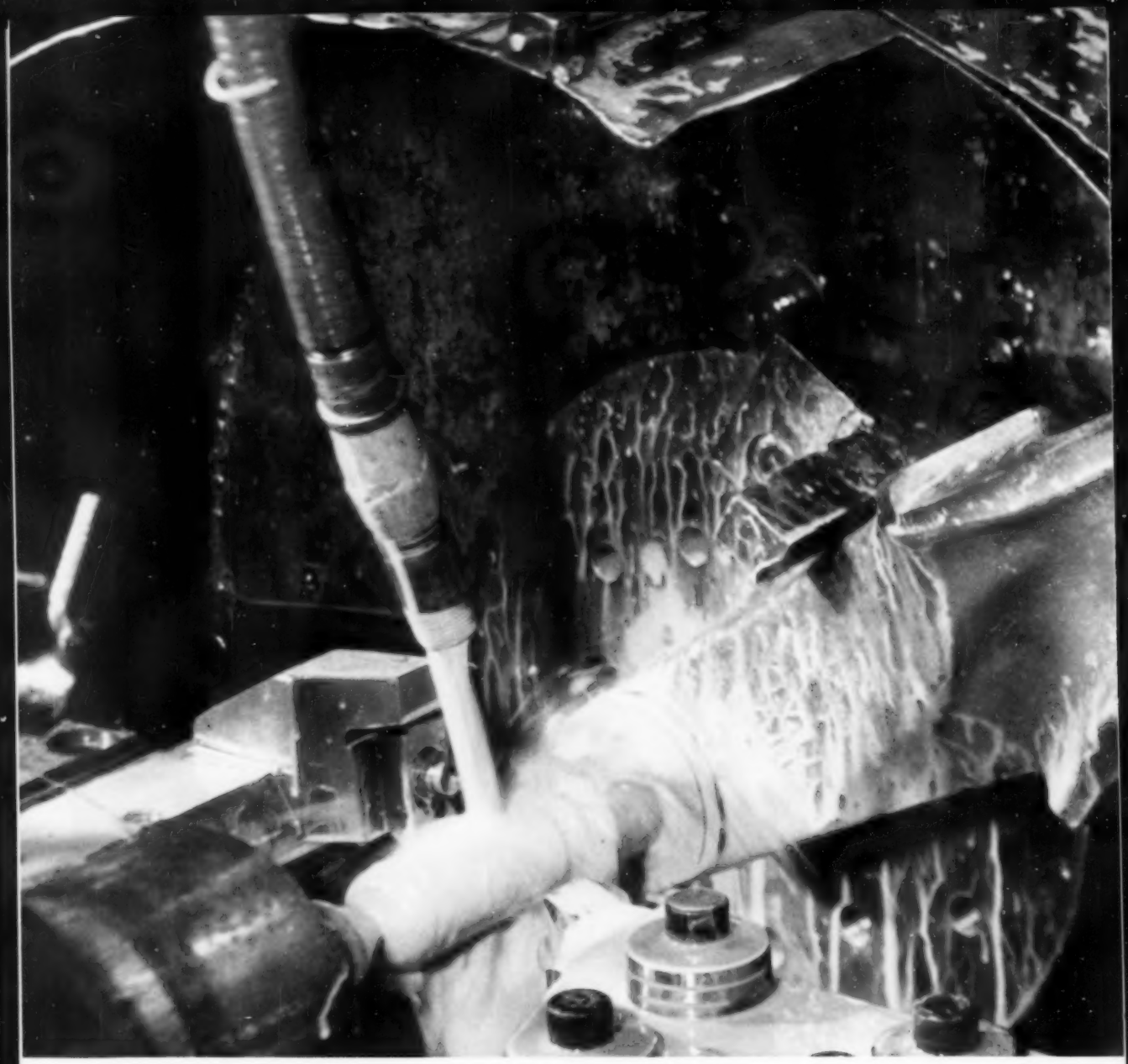

Ups cutting oil life 12 times with Gulfcut . . . more proof that

GULF MAKES THINGS

Not only the life of cutting oil, but the odor of it when rancid had once been a thorny problem in the Oil Tool Division of Reed Roller Bit Company, Houston, Texas, a major producer of oil well drilling tools.

Here's how they solved both problems with Gulfcut Heavy Duty Soluble Oil. Before they switched to Gulfcut, one department was changing cutting oils on the average of every two weeks. Reason: premature rancidity.

If the oil wasn't changed that often, the objectionable odor would become a personnel problem. Because it was changed that often, at least two man-hours were lost each time a machine was cleaned out. On top of this was the unnecessary cost of replacing oil that frequently.

The previous oil also tended to "clabber up" in the storage drums, especially in cold weather. This made it difficult to prepare the coolant charges. Reed solved all these problems with Gulfcut Heavy Duty Soluble Oil.

They reduced the frequency of cutting oil changes from an average of every 2 weeks to an average of every 6 months. Gulfcut Heavy Duty gave them over 12 times the service life! They had no more trouble with rancidity or solidification in storage.

What's more, in a water-oil ratio of 10-to-1, Gulfcut Heavy Duty Soluble Oil gives Reed's machinists the

Proof in production. These components for the new Reed Y tri-cone drilling bit were precision-bored in a turret drill cooled and lubricated with Gulfcut H.D. Soluble Oil. Boring operation at 550 sfpm. Carbide tool speed: 1,675 rpm. Cutting oil life in this operation: 6 months.

The Gulf man is there. Gulf Representative Jeff Bolling, right, talks to Reed shop superintendent A. R. Whiltsie about the merits of Gulfcut Heavy Duty Soluble Oil—which is used in a total of 21 lathes and drills in the Lugs and Bridges Department. All of the work involves alloy steels.

RUN BETTER!

constant work temperature and lubricity they need—for accurate sizing and desired surface finishes.

How about your operation? Gulfcut Heavy Duty Soluble Oil cuts machining cost through: longer cutting oil life, increased tool life, finer finishes, closer tolerances—and freedom from rancidity, foaming and solidification in storage.

Get the full efficiency-economy story on Gulfcut Heavy Duty Soluble Oil now. See how Gulf makes things run better, operation-wise and cost-wise. Call a Gulf Sales Engineer at your nearest Gulf office. Meanwhile mail coupon for new illustrated bulletin.

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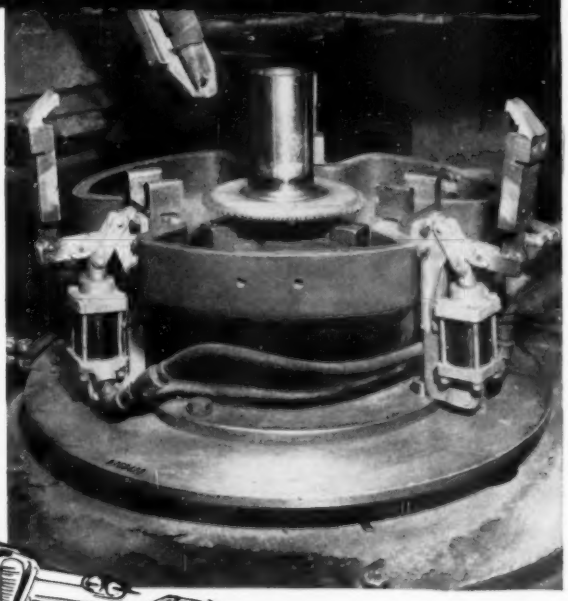
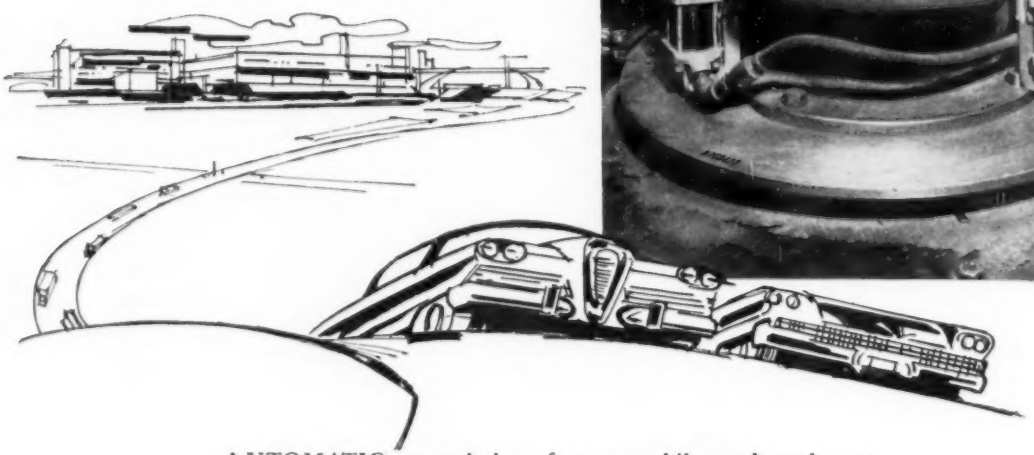
SP-9363

Weldynamics

ARC WELDING AT WORK CUTTING COSTS

How Weldynamics cuts costs—speeds production of automatic transmissions





AUTOMATIC transmissions for automobiles and trucks are being built faster and at less cost by the use of Automatic Lincolnweld Submerged Arc Welding.

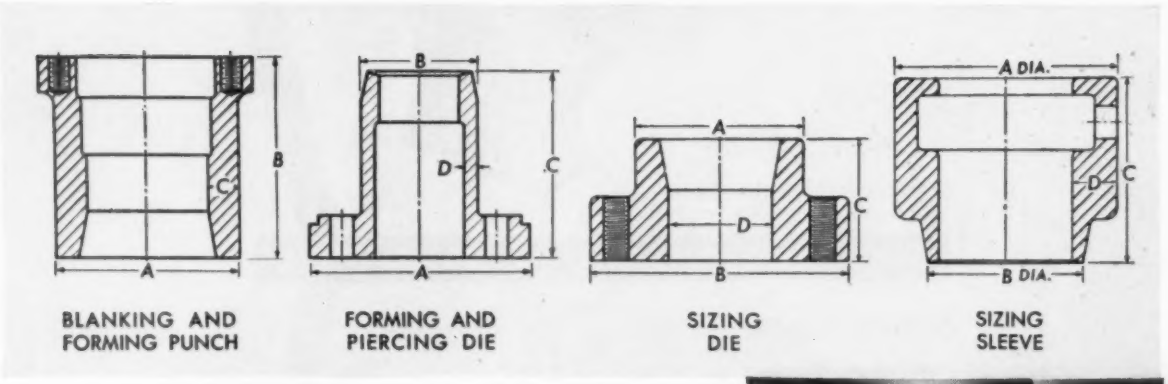
Automatic Lincolnweld Submerged Arc Welders are used in high-production jobs like this because Lincolnweld is reliable. Weld quality never varies, starts and stops are positive, and higher welding currents are faster.

Lincoln field representatives, trained in Weldynamics, will help you apply the cost-cutting advantages of Lincolnweld automatic welding to your production line. Strategically located in 54 cities throughout the U. S., or write:

The World's Largest Manufacturer of Arc Welding Equipment

THE LINCOLN ELECTRIC COMPANY • DEPT. 5024 • CLEVELAND 17, OHIO

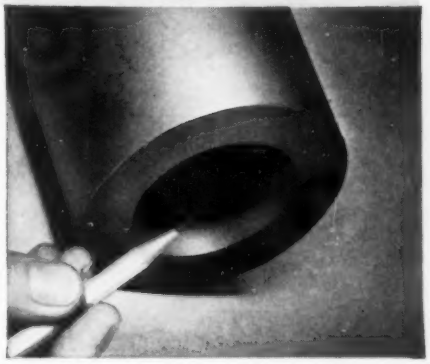
Do you make ring-shaped tool steel parts like these?



BLANKING AND FORMING PUNCH | FORMING AND PIERCING DIE | SIZING DIE | SIZING SLEEVE

Graph-Mo Hollow-Bar® can cut your costs because the hole's already there

Eliminates drilling, machines faster



YOU start with finish boring when you use Graph-Mo Hollow-Bar®. The hole's already there! Because drilling is eliminated, you cut costs and speed production. And you get a tool steel that machines faster, wears longer, gives more stability.

Graph-Mo machines faster than ordinary tool steels because of the free graphite in its structure. And there's far less tendency to pick up, scuff or gall.

Reports from users show that Graph-Mo outwears other tool steels three to one on the average. That's because of the combination of free graphite and diamond-hard carbides in Graph-Mo's structure.

And you won't find a more stable tool steel than Graph-Mo. Proof: after 12 years of use, a master plug gauge machined from Graph-Mo showed less than 10 millionths of an inch dimensional change.

Specify new Graph-Mo Hollow-Bar for all your ring-shaped tool steel parts. You'll save time and money, have a better finished product. It's available in O.D. from 3 to 16 inches with many wall thicknesses.

For more information write: The Timken Roller Bearing Company, Steel and Tube Division, Canton 6, Ohio. Cable: "TIMROSCO".

TIMKEN *Fine Alloy* **STEEL**

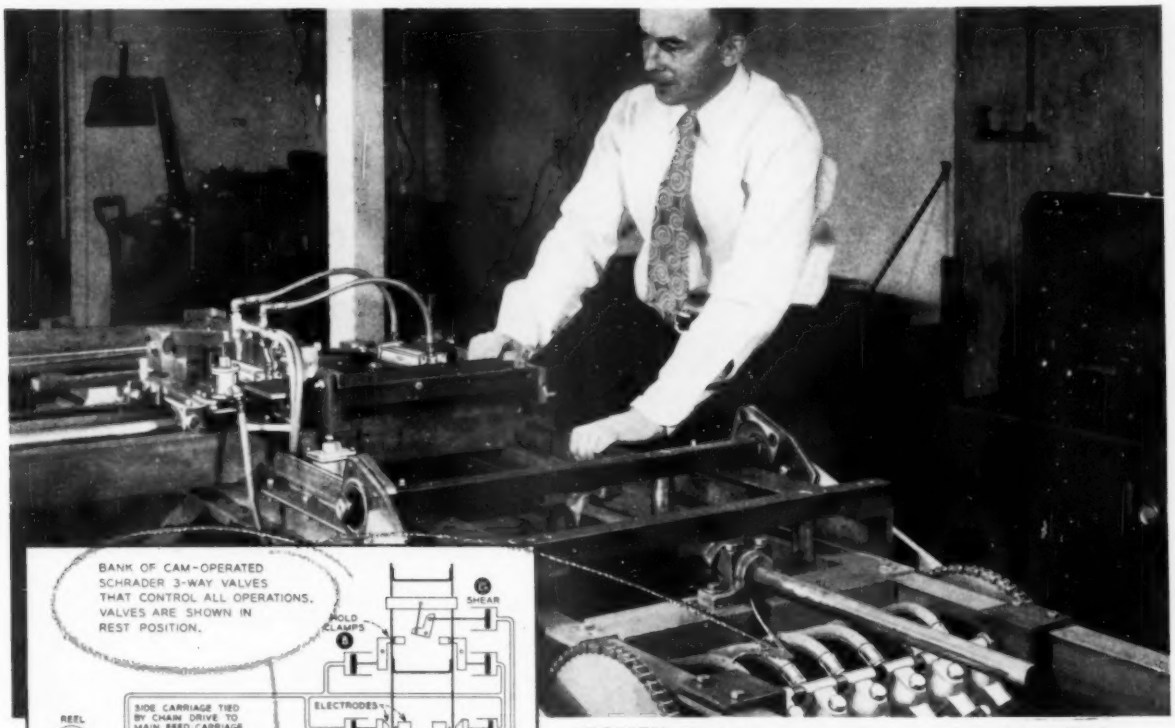
TRADE-MARK REG. U. S. PAT. OFF.

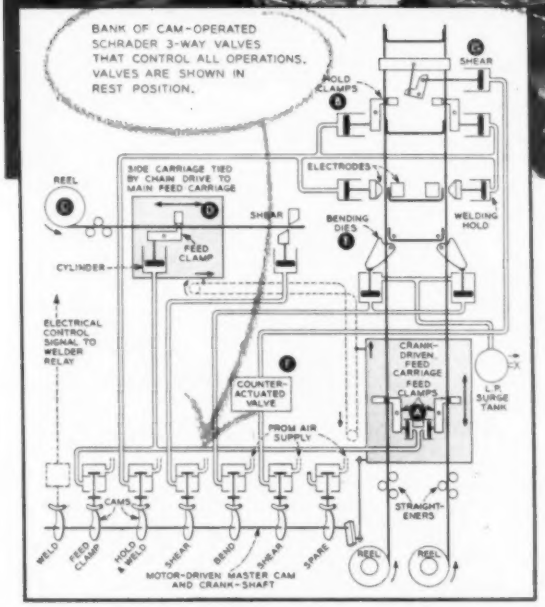
SPECIALISTS IN FINE ALLOY STEELS, GRAPHITIC TOOL STEELS AND SEAMLESS STEEL TUBING

YOU, TOO, CAN AUTOMATE IT YOURSELF ...WITH SCHRADER AIR PRODUCTS

Very often you can automate manufacturing operations simply by applying Schrader air controls to existing plant facilities.

Here's a man with ideas who automated a complex job—increased production, reduced unit costs, safely and easily—without making a large capital investment. He did it with a planned Schrader air control system. Chances are excellent that you can do the same thing—with Schrader air products. Air can do an almost limitless range of work: automatic drilling, reaming, clamping and holding, shearing, forming, staking, grouping and interlocking assembly operations for quicker parts handling and assembly.





PROBLEM: Feed heavy wires into machine, shear off pieces, shape them, weld pieces together and eject as finished wire webbing. Fast. Economically. Automatically.

SOLUTION: Air Controls selected from Schrader's complete line. Neat bank of valves—actuated by cams on master cam shaft—operate synchronized system. Clamps A feed wires to holding Clamps B as carriage moves back and forth. Counter-actuated valve F operates cut-off shear G after desired number of cycles. Wire C, fed from carriage D, is sheared, formed by dies E, welded to the other two wires.

RESULT: One man performs *double* the output of three men at a fraction of the cost of a new machine.

Design it yourself! Schrader Air Control components—the most reliable self-contained power units—can help you adapt quickly to your manufacturing needs.

Schrader®
a division of SCOVILL

QUALITY AIR CONTROL PRODUCTS

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462 Vanderbilt Ave., Brooklyn 38, N. Y.
How do I start? How did others get started? Send me informative literature and information about Schrader's Automate-It-Yourself Air Products.

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Company_____

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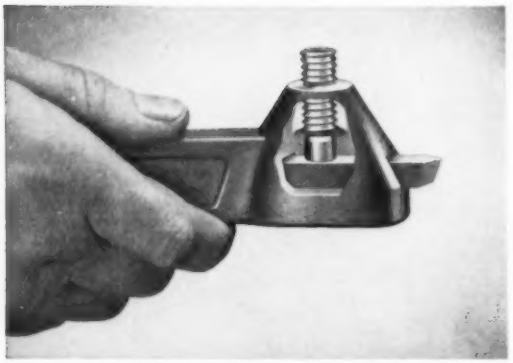
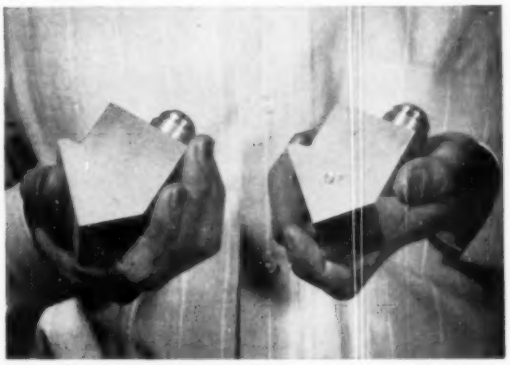
Practical Tooling Tips

Number 1 of a series.

Everyday more and more shops are using standard Vlier Tooling Accessories in place of custom-made devices for both tooling and original equipment applications. The precision construction, product uniformity and quick availability of these simple time-savers have made them tool room favorites. Why don't you start saving from their use?

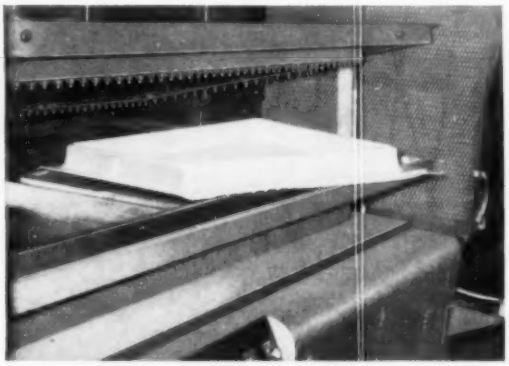


TO GET GREATER TOOL BIT RIGIDITY replace the tool holder screw with a Vlier Swivel-Pad© Clamp. The large, flat pad face provides many times more clamping area. Bits can be held tighter, reducing chatter and vibration. Small, narrow cut-off blades, multipoint tools, even stub ends can be rigidly held. Unique ball joint construction gives smooth angle adjustment in all directions.



EASY WAY TO STOP MARRING surface of part held in fixture. The part on the left was securely held in the fixture with a Vlier Swivel-Pad© Clamp. The scrapped part on the right was held with an ordinary set screw. With the Vlier Swivel-Pad© Clamp the pad stops at first contact with the part; screw torque is absorbed by a ball, preventing damage to the part. This exclusive ball joint construction also provides adjustment to off-angle surfaces.

SPRING PLUNGERS LET WRENCH DO MULTIPLE DUTY—The compression tool shown above is used to attach connectors to electrical wires. Formerly, each size wire connector required a different size tool. But now, through the use of Vlier Spring Plungers, one tool attaches all sizes of connectors—through the use of changeable jaws. The appropriate jaw for any size connector is easily inserted, accurately positioned, and held in place with a Vlier Spring Plunger.



THE RIGHT AMOUNT OF END PRESSURE AND NO MORE is what this spring plunger application calls for. More than 150 Vlier Spring Plungers are used to hold a plastic sheet in position during the forming operation of a plastic refrigerator door liner. Spring Plungers provide just the right amount of pressure to produce a perfect liner.

New catalog now ready! Send for your copy today.

Insist on Vlier Tooling Specialties... there's still no substitute for quality.

VLIER ENGINEERING CORPORATION

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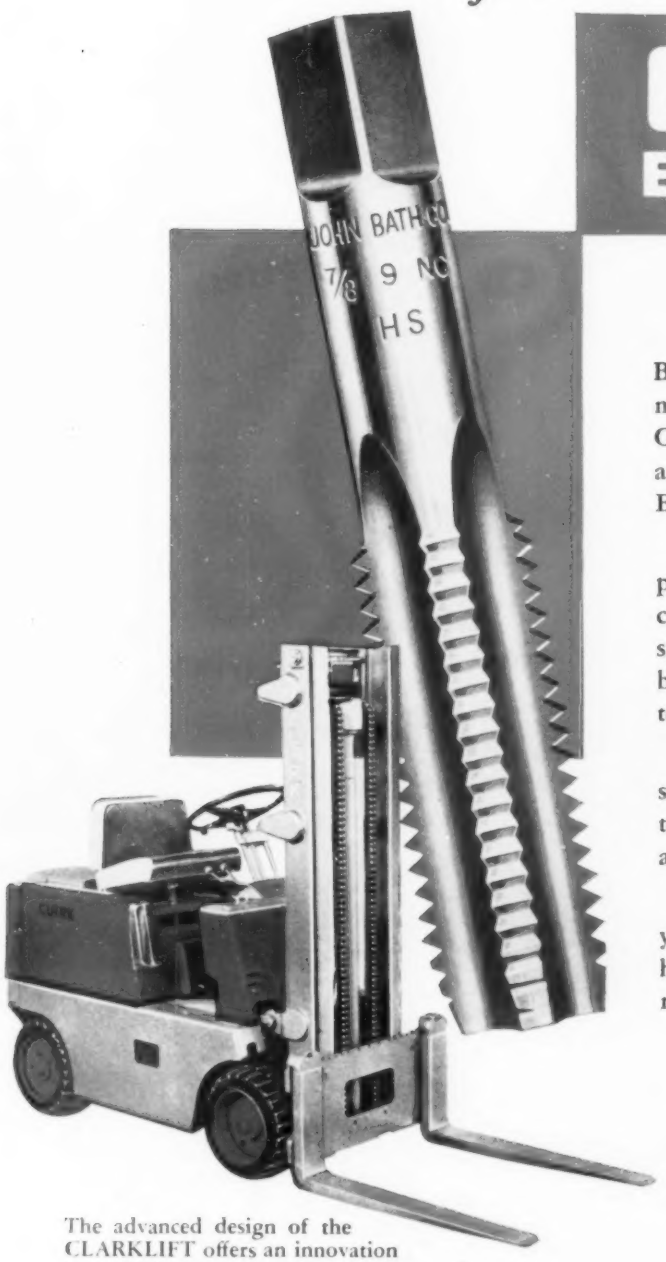
another Bath Tap job well done . . . for

CLARK® EQUIPMENT



The advanced design of the CLARKLIFT offers an innovation in control, operator's safety, comfort and ease of maintenance.

Bath is proud to have a share in the manufacture of precision parts for CLARKLIFT industrial trucks, built at the Battle Creek plant of the Clark Equipment Company.

The smooth, efficient action of these popular trucks depends on well-made components . . . threaded to exact specifications with Bath taps that can be depended on to maintain accurate tolerances.

As demonstrated by Clark . . . the selection of Bath taps contributes toward a higher standard of performance of the end-product.

A representative will be glad to tell you how Bath engineers are trained to help you solve tapping problems and reduce production costs.

for the best buy ...buy Bath

JOHN BATH & CO., Inc.
28 Mann St., Worcester, Mass.

CYLINDRICAL AND THREAD GAGES • GROUND THREAD TAPS • INTERNAL MICROMETERS

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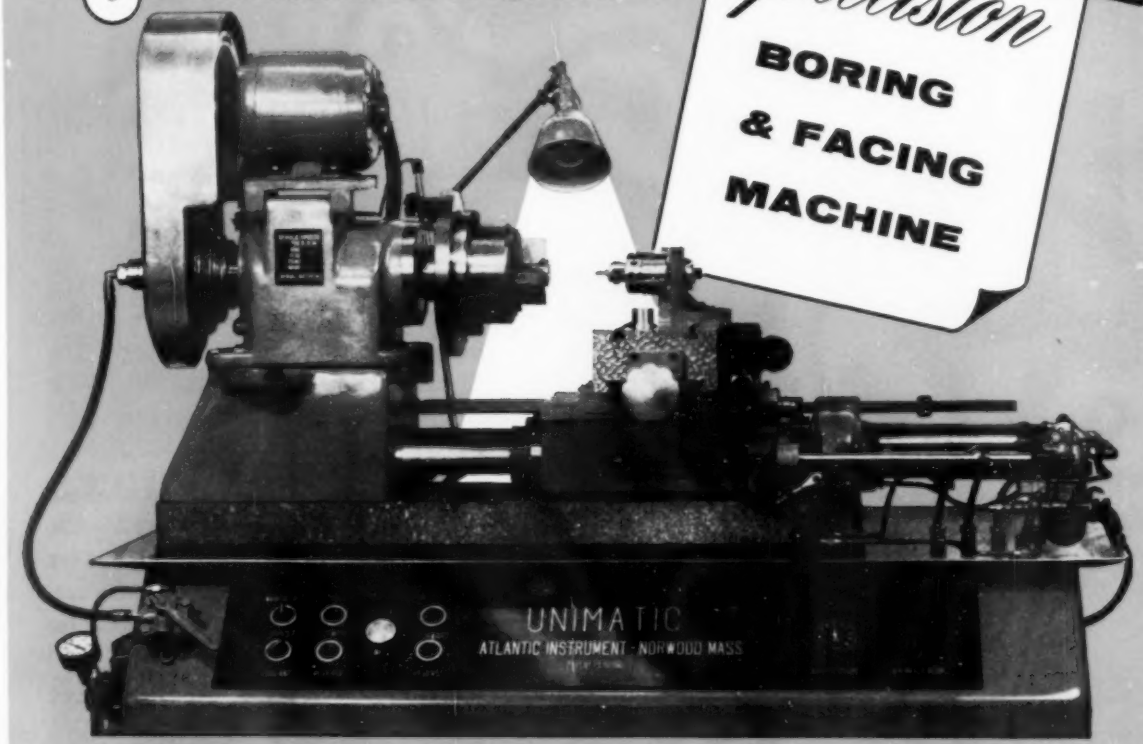
UNIMATIC...

HIGH *precision* **BORING & FACING MACHINE**



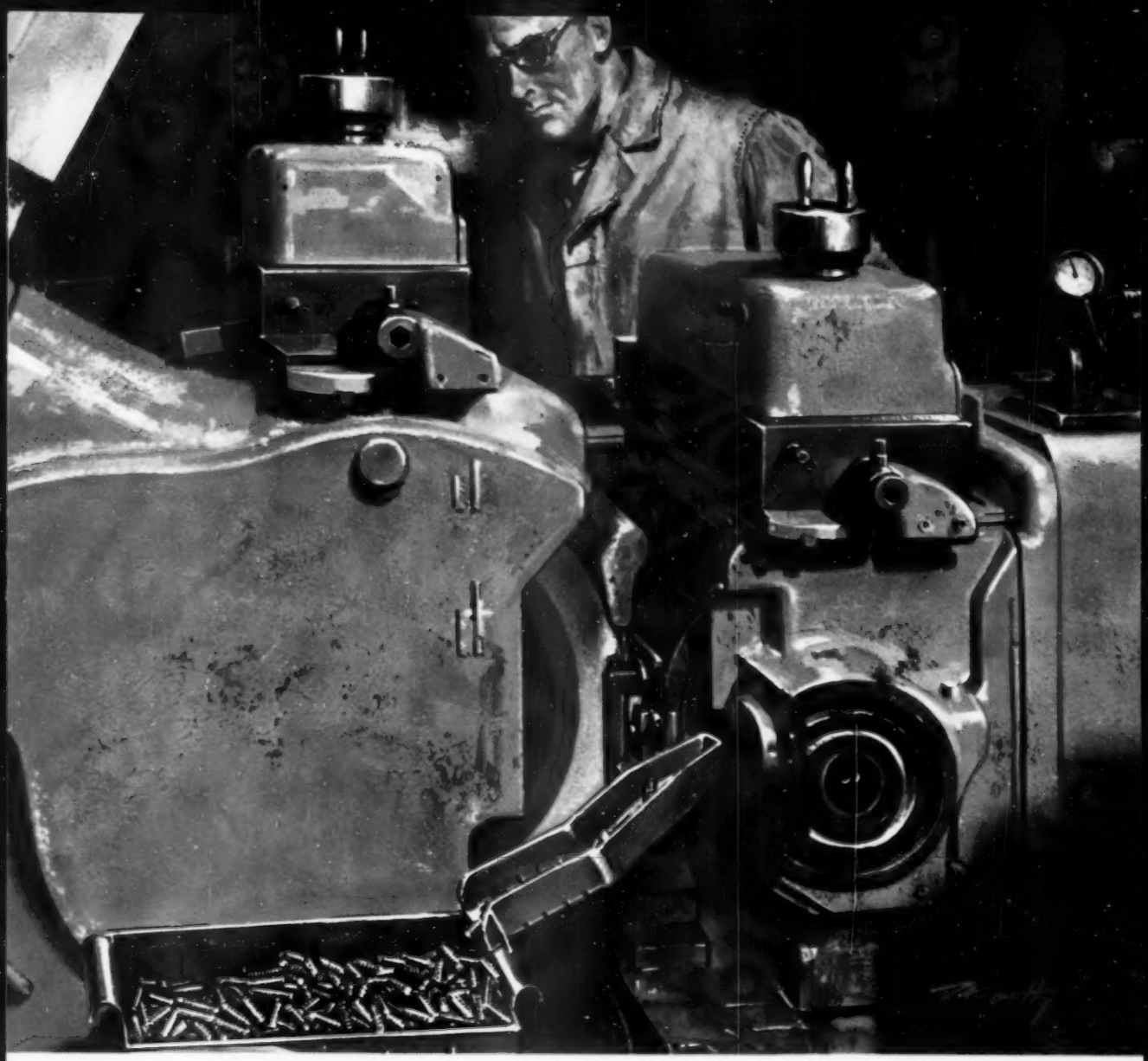
FEATURES . . . 1) **AUTOMATIC CYCLING**
2) **VARIABLE FEED** approaches and returns
3) **GUARANTEED** to hold work to .0002"

Designed and built by ATLANTIC INSTRUMENT COMPANY for their own use . . . and now offered as a type and size of machine for which there is a strong demand, especially in the instrument and allied industries, where close tolerances must be held.

The UNIMATIC *comprises an extremely accurate machine element, mounted on a granite base scraped to a tolerance of .00005", with other features (fully explained in our catalog) neutralizing the effects of temperature variations.*

RUSSELL, HOLBROOK & HENDERSON, INC.

292 Madison Avenue, New York 17, N. Y.



How 7,000 pieces per hour get the "Touch of Gold"

Here a centerless thread grinder is adding value the most modern way . . . applying the "Touch of Gold" automatically, with a Norton crush-trued wheel that is grinding threads in set screws at an average rate of 7,000 per hour.

You too can benefit by Norton leadership in continually improving grinding wheels and grinding methods . . . which helps proportion your labor, overhead and wheel costs as favorably as possible, so that you can produce with increased efficiency and economy.

Norton stocks more than 200,000 types and sizes of grinding wheels . . . and brings to every industrial area the many products and services that have become synonymous with the "Touch of Gold".

NORTON COMPANY, General Offices, Worcester 6, Massachusetts.

NORTON
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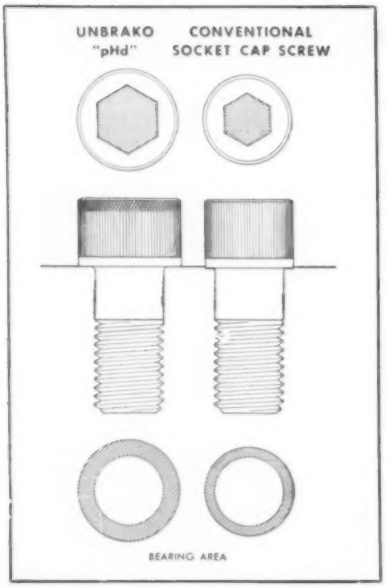
Making better products . . . to make your products better

Up to 233% more holding power with NEW UNBRAKO *pHd** socket cap screws



***pHd stands for "proper head design"—a factor in higher product reliability**

Enlarged head diameter, without change in head height, increases usable fastener strength as much as 134%, provides as much as 233% more holding power. The greater clamping force achieved with the new UNBRAKO pHd means longer fastener life under dynamic loads, offers the following advantages:

- Miniaturization. Space and weight-saving through use of smaller diameter or fewer screws. The 170,000-190,000 psi of these fasteners can be used to greater advantage.
- Reduction of fatigue failures. pHd allows consistently higher preloading, a major factor in lengthening the fatigue life of threaded fasteners.
- Fewer loosened threaded fasteners under shock or vibration.
- Eliminates washers under the heads of cap screws where they are used to increase the effective bearing area.
- Minimizes effect of oversized holes on the head-bearing area.

The head diameter, enlarged on 5/16, 7/16, 9/16‡, 5/8, 3/4, 7/8 and 1 in. sizes, also prevents the screw head from indenting the material being assembled—a fault that normally reduces, and sometimes completely loses, the vital preload or tensile stretch that keeps the screw tight and prevents fatigue failure. pHd also provides room for a bigger socket, which permits tightening to higher recommended preloads.

COMPARISON OF UNBRAKO pHd AND CONVENTIONAL DESIGN

Each size can now be utilized with equal reliability. The bearing stress is consistent from size to size in the new UNBRAKO pHd socket cap screws.

SCREW SIZE	HEAD DIAMETER (in.)		BEARING AREA (sq. in.)		LOAD TO INDENT IN CAST IRON (lb.)		% INCREASE USABLE STRENGTH	TIGHTENING TORQUE (lb.-in.)†	
	Old	pHd	Old	pHd	Old	pHd		Old	pHd
1/4	.375	.375	.041	.041	3,280	3,280	–	165	180
5/16	.438	.468	.047	.072	3,760	5,760	54	325	360
3/8	.562	.562	.102	.102	8,150	8,150	–	600	660
7/16	.625	.656	.116	.148	9,270	11,800	27	1,000	1,040
1/2	.750	.750	.188	.188	15,000	15,000	–	1,450	1,590
9/16‡	.812	.843	.209	.247	16,700	19,700	18	2,050	2,270
5/8	.875	.937	.203	.305	16,200	24,400	51	2,900	3,190
3/4	1.000	1.125	.223	.432	17,800	34,600	94	5,050	5,600
7/8	1.125	1.312	.254	.594	20,300	47,500	134	8,000	8,900
1	1.312	1.500	.364	.785	29,100	62,800	116	10,550	13,600

†Normal recommended seating torques for unplated screws, fine threads

‡Available as a special only (listed for dimensional data)

High Reliability

SPS research is continually developing fasteners with higher and higher standards of predictable performance. By installing SPS high reliability fasteners in your assemblies, you increase your overall product reliability.

"High Reliability" is a booklet just published by SPS. Write for your copy today.

The new UNBRAKO pHd socket head cap screw is now available through all authorized industrial distributors at no increase in price. Specify UNBRAKO pHd when ordering. For technical data and specifications, send for Bulletin 2406. Unbrako Socket Screw Division, STANDARD PRESSED STEEL CO., Jenkintown 37, Pa.

We also manufacture precision titanium fasteners / write for free booklet

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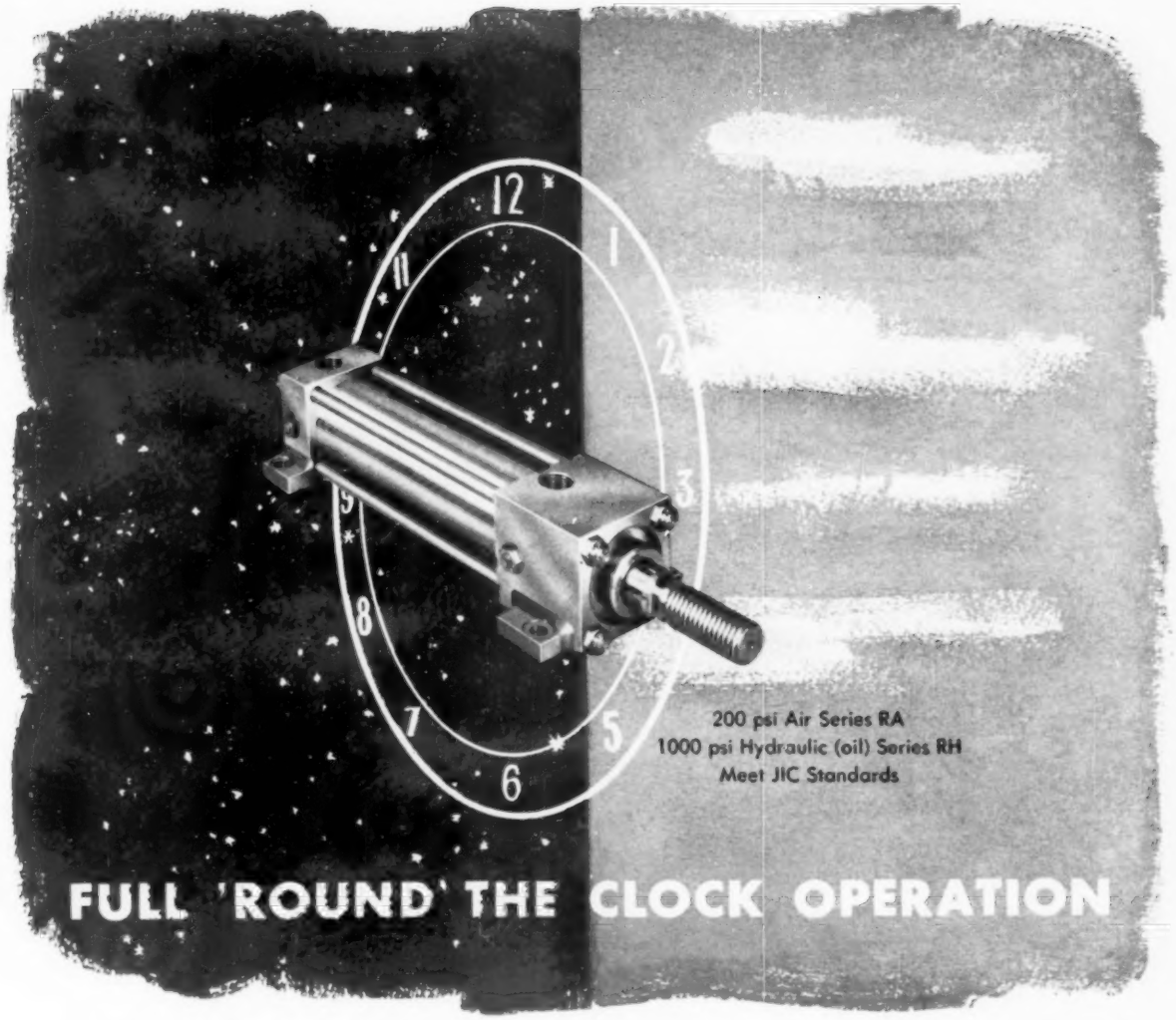

O-M AUTOMATION heavy-duty air and hydraulic cylinders

O-M Automation Air and Hydraulic Heavy-duty Cylinders are the result of years of research and engineering "know-how". Designed to the automotive industry's Automation Standards, they fill a definite need for outstanding durability under the most exacting demands of today's high speed automatic production.

Tested, tried and proved in actual service, these ruggedly constructed components hold untold promise for design engineers who seek to combine continuous, smooth dependable and efficient straight line motion with long life and minimum maintenance. Available in 1½" to 8" bores with front flange, rear flange, clevis, trunion or foot mount.

These and many other advanced features of O-M Automation Cylinders, that make for maximum efficiency and long life with minimum servicing, are described in our new catalogues—107 for Air Cylinders—108 for Hydraulic Cylinders. Write for your copy TODAY!

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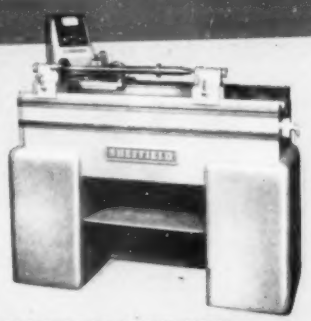
ACCUTRON COMPARATOR

Amplifications (Dual): 1000/2000, 2500/5000, 5000/10000, 10000/20000, 20000/40000.
Vertical capacity: 5¼".
Gaging pressure (oz.): 2—4—8—16—40.



ACCUTRON LEADCHEK

Amplifications (Dual): 1000/2000, 2500/5000.
Capacity: 10" dia.—36" long. Micrometer dial graduated to "tenths".

ACCUTRON GAGE BLOCK COMPARATOR

Amplifications (Dual): 10000/20000, 20000/40000, 50000/100000. Capacity: 0"—4".
Gaging pressure (oz.): 2—4—8—16—40.

ACCUTRON INTERNALCHEK—MODEL N-7

Amplifications (Dual): 1000/2000, 2500/5000, 5000/10000.
Gaging dia.: .370"—12".
Gaging depth: 1½".

ACCUTRON RING CHECKING INSTRUMENT

Amplifications (Dual): 1000/2000.
Min. size of work: 1" ID. Depth: 5½".

ACCUTRON INTERNAL DIMENSION GAGE

Amplifications (Dual): 1000/2000, 2500/5000, 5000/10000, 10000/20000,
Capacity: 4¼"—36¼".

ACCUTRON AMPLIFIER AND ELECTRO-JET PICK-UP UNIT

Amplifications (Dual): 1000/2000, 2500/5000, 5000/10000, 10000/20000, 20000/40000, 50000/100000.

ACCUTRON HORIZONTAL EXTERNAL COMPARATOR

Amplifications (Dual): 1000/2000, 2500/5000, 5000/10000, 10000/20000.
Gaging capacity: Up to 6".
Gaging pressure (oz.): 2—4—8—16—40.

ACCUTRON HEIGHT INDICATOR

Amplification (Dual): 1000/2000, Vertical range: 0"—26".

For Detailed Information on any of these instruments, write to the Sheffield Corporation, Dayton 1, Ohio, U.S.A., Dept. XX.

MICRO-HARDNESS TESTER

Vertical capacity: 2⅜".
Vice capacity: 1 11/16".
Microscope magnifications: 200 x and 400 x.

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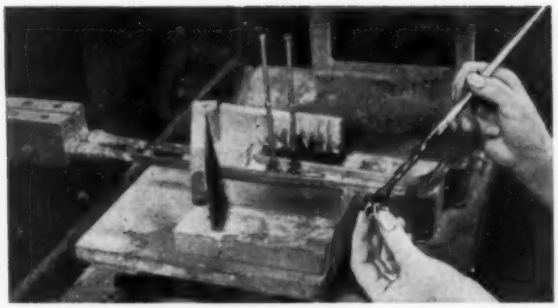
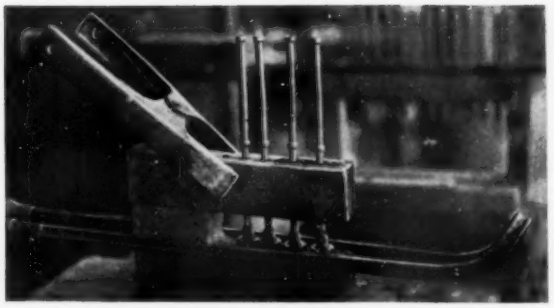


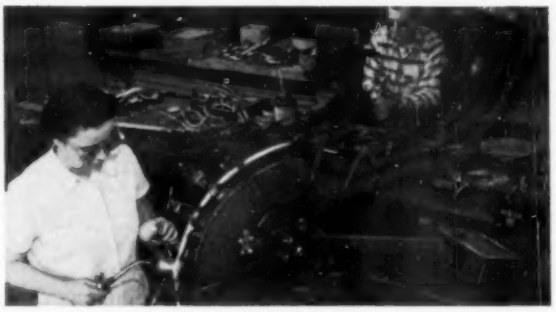
Operator applying Special Handy Flux Type B-1 to components of de-icer tube before brazing.



Here, four de-icer assemblies in jig are being brazed by induction heat.

First step in brazing manifold. Operator applies Special Handy Flux Type B-1 to joint area prior to hand brazing. B-1 Flux is particularly effective in removing refractory oxides such as those formed in stainless steels and carbides.

Operator preheats joint area before hand feeding Handy & Harman silver alloy Braze 541.



Here, two different parts are being brazed. Operator in foreground hand feeds alloy on aircraft manifold joint while operator in background brazes nipple on hydraulic oil filter. Gas-air hand torches are used in both cases.

Here's how you can get uncompromising **JOINT STRENGTH** at **LOW-COST**... Handy & Harman **SILVER BRAZING**

The first requisite for virtually any aircraft part is unimpaired strength. Jerden Manufacturing Company, Indianapolis, makes a number of tubular aircraft parts and components and each of them must pass rigid tests before acceptance. Three of the components are a hydraulic aircraft filter, a manifold assembly and a de-icing tube. Tubes and fittings are 410 and 321 stainless steel, brazed with Handy & Harman silver alloy Braze 541 (formerly 4772).

Handy & Harman's Braze 541 is specifically formulated for brazing stainless steels. It has a high flow point (1575°F), and its excellent strength at elevated operating temperatures especially recommends it for many aircraft component applications. Braze 541 is a "tailor-made" brazing alloy, designed to do a specific joining job and do it particularly well. It is an example of Handy & Harman's ability to supply a specific alloy to fit a specific need, a service that remains constantly available to you.

You may find that your metal joining requirements are more or less special or you may not be fully aware of what you require. In any case, we invite you to consult us about what you are joining and *would like to join better*. We may be able to help you from many points of view: economy, joint strength, conductivity, ease of production and many others.

GET THE FACTS

Technical Bulletins T-1 and T-2 give the general characteristics of silver brazing alloys plus the compositions, melt and flow points of 32 separate alloys. Write for your copies.

Your NO. 1 Source of Supply and Authority on Brazing Alloys

HANDY & HARMAN

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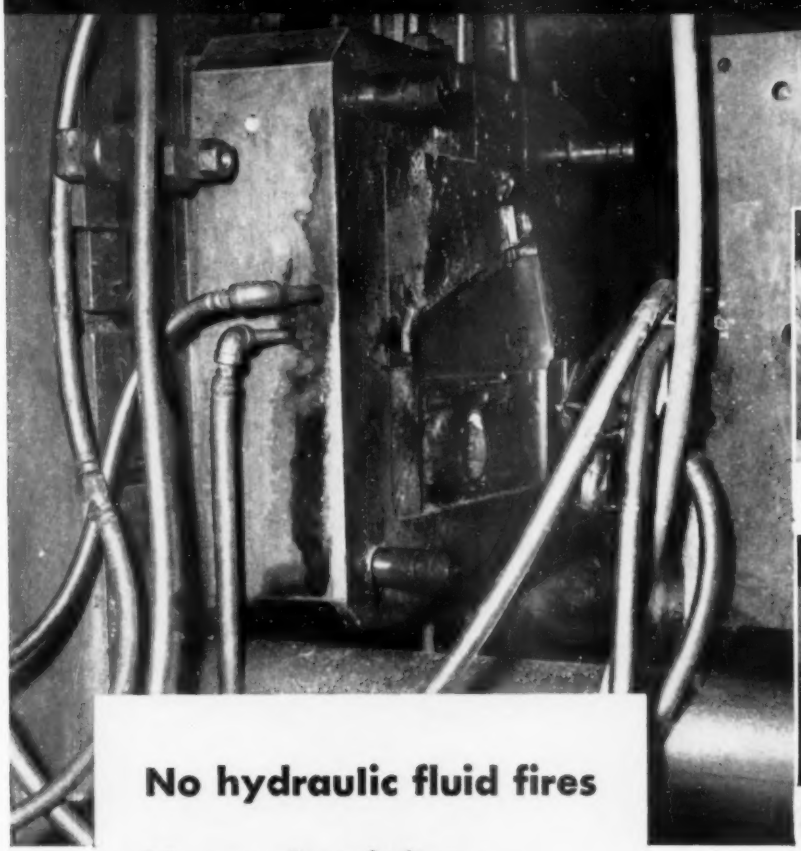
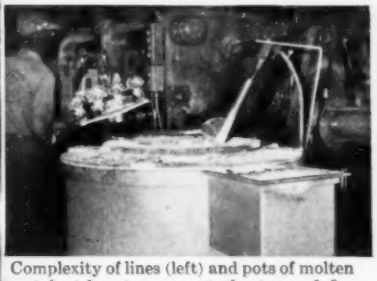
"For 3 solid years—



Irus Fluid's distinctive yellow color makes it easy to spot and trace leaks.



Complexity of lines (left) and pots of molten metals (above) represent the type of fire hazards requiring Shell Irus Fluid 902.

No hydraulic fluid fires

No worker injury

No equipment damage —since we switched over to

SHELL IRUS FLUID 902"

says Ernie Ike, Plant Superintendent
Western Die Casting Co., Emeryville, Calif.

According to Mr. Ike, these results are directly due to the switch-over in 1955 from conventional hydraulic fluids to Shell Irus Fluid 902.

Irus® Fluid 902 is a special combination of petroleum oils mixed with water and emulsifying agents. Its fire resistance is achieved through the relatively high water content. Irus snuffs out fire, *under plant conditions.*

Another important advantage of Irus Fluid 902 is its low cost. Plant operators now using Irus have discovered that Irus Fluid costs up to one-third less than other fire-resistant fluids . . . yet is comparable in performance in every practical respect.

If the hydraulic equipment in your plant is exposed to fire hazards, let a Shell Industrial Representative show you the advantages of Irus Fluid 902. Write Shell Oil Company, 50 West 50th St., New York 20, N. Y. or 100 Bush St., San Francisco 6, Calif.

SHELL IRUS FLUID 902

a low-cost, fire-resistant hydraulic fluid

SHELL

Made in West Germany

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Utmost accuracy and versatility

Combines a series of different measuring instruments

•

Write for booklet on this most advanced instrument

This new instrument enables you to handle the most varied problems with the greatest ease. Measurements can be made in plane rectangular and polar coordinates as well as in three-space rectangular and cylindrical coordinates.

The instrument embodies high precision glass scales and circles which can be read respectively to .00005 inch and 1′ of arc. By means of a new beam-splitting device, line and center symmetrical measurements can be made by a single or double reversed image in complementary colors. Certainty of setting is thereby greatly increased, and extremely difficult precision parts can be checked in far shorter time, with higher accuracy than ever before.

An optical internal-measuring device permits measurements of smallest holes without any physical pressure.

Inclined binocular tube affords most comfortable viewing. Push-button control automatically projects the specimen image and all scales into binocular tube. Offers many other features such as comparison drawing device, projection and photographic attachments, etc.

CARL ZEISS, INC.

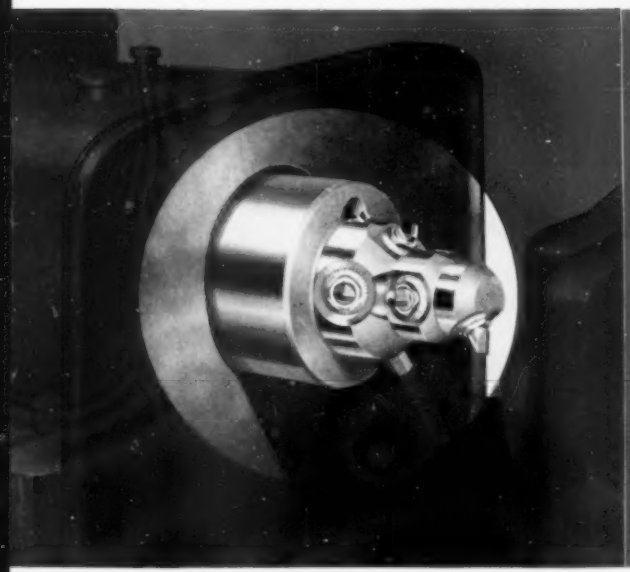
485 FIFTH AVENUE, NEW YORK 17, N. Y.

GUARANTEED UNINTERRUPTED REPAIR SERVICE

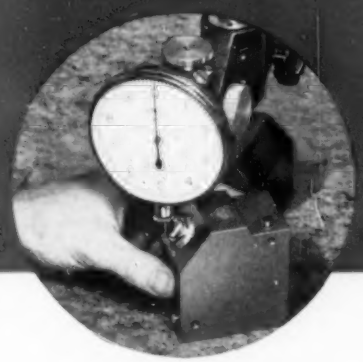
now, pre-set tools to accurate part dimensions outside the machine with this new Microbore® System

SIMPLE 4-STEP PROCEDURE

1. To set up pilot tool, insert Microbore "Pre-Set" unit in boring bar. Adjust to part dimension by trial cut and final setting using Micrometer Vernier adjustment.



2. Remove adjusted pilot tool from the boring bar and install in the standard Microbore setting block.



3. Position indicator and set on high point of pilot tool in setting block and adjust indicator to zero.

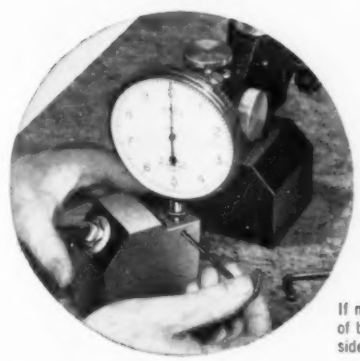
Eliminate trial cuts... change tools in seconds... simplify tool maintenance

Using a standard setting block and indicator, Microbore tools can now be pre-set to accurate part dimensions outside the machine and quickly locked in the boring bar or tool holder without further adjustment.

"Pre-Set" eliminates scrap parts due to trial and error set-up and greatly reduces down time for worn tool point adjustment. "Pre-Set" encourages the operator to keep sharp tools in the machine assuring greater accuracies and produces the maximum number of pieces per tool grind by minimizing breakage due to dull tools.

"Pre-Set" also makes it possible to replace worn tools without changing the entire boring bar or tool holder—eliminates the need for stand-by bars —simplifies tool grinding and maintenance.

Microbore System of "Pre-Set" tooling may be applied to boring, turning, facing and chamfering operations and is especially suited to production and automated operations where machines must maintain peak production on long runs. Write for complete information.



4. Adjust gage pin to same zero setting. Any number of additional tools may now be pre-set and interchanged with pilot for precision boring the same diameter.

If necessary to pre-set for depth of bore, tumble block to adjacent side and repeat procedure.

The DeVlieg Microbore System of Adjustable Precision Tooling includes Standard Microbore Boring Bars and Boring Bar Sets, Special Cluster Tooling, Flash-Change Tooling and Tool Holders, Flash-Change Replacement Bridgeport Spindles, Turret Lathe Turning Heads and Adjustable Boring Heads.

DeVlieg Microbore® System

DE VLIEG MICROBORE • DIVISION OF DE VLIEG MACHINE COMPANY

Fair Street, Royal Oak, Michigan

KEEPS CUTTING FLUIDS
AS FRESH AS A DAISY

Here's why ELCIDE 75™ can increase the useful life of your soluble oil emulsions

Elcide 75 controls harmful bacteria that enter all oil-water emulsions and cause rancid odor, acidic corrosion, and emulsion breakdown. Prior to the development of Elcide 75, certain bacteria developed immunity to commonly used germicides, and no single inhibitor could control their damage.

Elcide 75 is a combination of proven anti-bacterial agents, including one of the safest and most powerful bacterial inhibitors used in the exacting field of medical surgery today.

Elcide 75 is not a "built-in additive" that is weakened by larger emulsion ratios. With Elcide 75 you know you have an effective, safe treatment because you add it to the emulsion right in your own plant.

Elcide 75 is completely safe for employees, machinery, and products. Not only is it non-toxic and harmless to sensitive skin, but its anti-bacterial action reduces the chance for infection caused by contaminated emulsions. The use of Elcide 75 also reduces the acidic corrosion caused by bacterial decomposition.

Bacteria cause emulsion trouble. This is a photomicrograph of *Pseudomonads*, one of the harmful types of bacteria found in oil-water emulsions. They enter the emulsion through the air, water, and plant debris, and make it possible for sulfate-reducing bacteria to cause odor, corrosion, and emulsion breakdown. Elcide 75 controls a much wider range of these and other types of damaging bacteria.

WHAT ELCIDE 75 MEANS TO THE METALWORKING INDUSTRY...

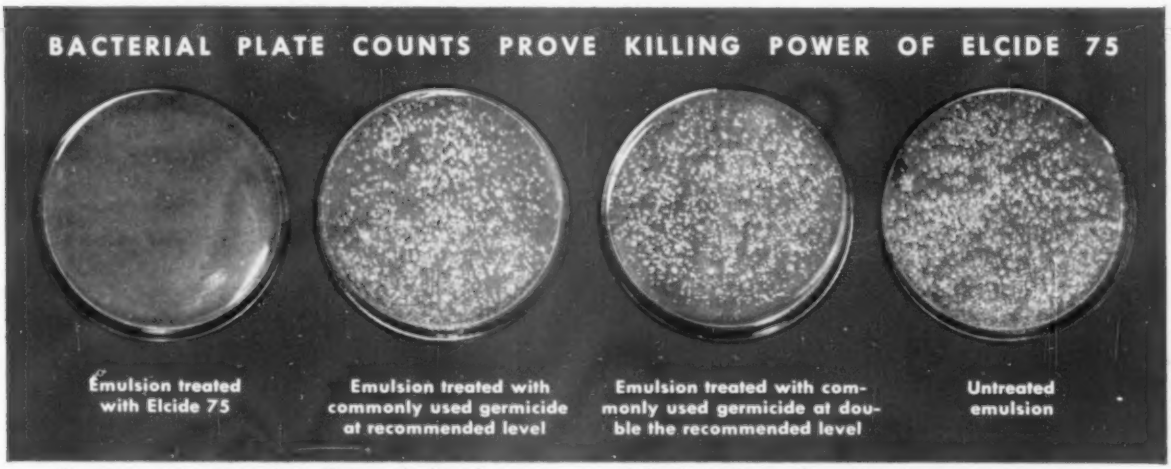
Operating costs can be greatly reduced because of Elcide 75. This saving is an accumulation of several important benefits.

Actual shop tests have shown that one ounce of Elcide 75 added to each four gallons of emulsion can keep the oil-water emulsion fresh as much as 5½ times longer. In one test, emulsions that normally had to be dumped at the end of four weeks ran for 22 weeks when treated with Elcide 75!

You can benefit by three direct savings—costly labor and down time for recharging will be reduced, your soluble oil requirements will drop, and the disposal cost of spoiled emulsions will diminish.

Elcide 75 also contributes to better products and longer machine tool life because it controls the bacteria which often cause acidic corrosion.

You can have a cleaner plant by using Elcide 75. It eliminates objectionable odors as well as bacteria that may cause skin infection. Elcide 75 is nontoxic and safe to use, as proved by tests conducted under normal shop conditions.



The photographs shown above illustrate the broad, powerful anti-bacterial action of Elcide 75. The light areas are bacterial colonies that have grown in three of the emulsion samples during 8 weeks' use. Note that none of these harmful bacteria appear in the emulsion treated with Elcide 75 during the same 8-week period. The emulsion stayed fresh.

PUT ELCIDE 75 TO WORK FOR YOU

The best way to determine the value of Elcide 75 to your own operation is to try it under normal plant conditions, using your regular oil-water emulsion. After you compare the costs of operation, you will agree that Elcide 75 is a valuable discovery that deserves a permanent place in your plant. Why not try Elcide 75 soon?

ELCIDE 75

Lilly

PRODUCT SPECIFICATIONS
ELCIDE 75

(Lilly's brand of bacterial inhibitor for cutting fluids)

Active Ingredients—Sodium Ethylmercuri Thiosalicylate (Thimerosal) and Sodium *o*-phenylphenate.

Package	Price per Gal.
1-gallon polyethylene	$8.50
5-gallon polyethylene	$8.00
55-gallon stainless steel	$6.50

This product is sold only through selected distributors.

For further information or to place your order, write or phone:

ELI LILLY AND COMPANY, AGRICULTURAL AND INDUSTRIAL PRODUCTS DIVISION, INDIANAPOLIS 6, INDIANA

TELEPHONE: MElrose 6-2211

you can get

This A.S.T.E. exhibit showed visitors how the winning combination that matches machine, work and cutters was found for companies like yours

the winning combination!

Write for this new book which tells more about this unusual Cutter Division service. It also describes and illustrates the standard and special inserted blade cutters being used by hundreds of companies to cut costs and improve performance.

The Key to Lower Cost Chips is found by matching the *right* cutter to the machine and to the work.

The Cutter Division of The Ingersoll Milling Machine Company offers you a unique source of assistance. The combination of *your own* knowledge of conditions in *your* shop and our broad experience in working with so many others assures reduced costs and better cutting performance for *you*.

No matter what make of machine you use for milling or boring —no matter what metal or size or shape of piece—this service may lead to important competitive advantages. You have much to gain . . . nothing to lose by giving us an opportunity to study, with you, in your shop, the many factors involved in arriving at the winning combination *for you*. Just let us know when it would be convenient to get together. Write to:

CUTTER DIVISION

THE INGERSOLL MILLING MACHINE COMPANY

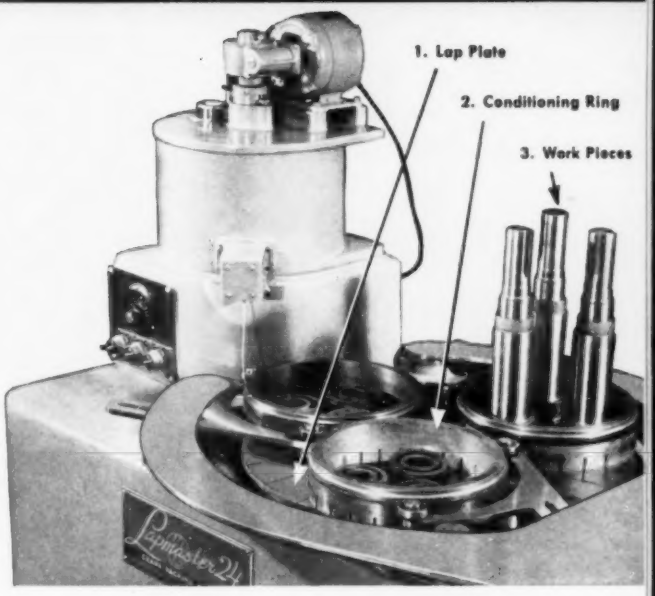
505 FULTON AVENUE ROCKFORD, ILLINOIS

FACTS ABOUT HOW PRODUCTION LAPPING SAVES YOU MONEY—IMPROVES YOUR PRODUCT

With the *Lapmaster*® Principle

The Lapmaster is a versatile precision machine engineered to production *lap* flat surfaces within tolerances of .0000116" or less and microinch finishes of 2 to 3 RMS with absolute uniformity. *Here's how it works:*

1. **Heavy cast iron lap plate revolves slowly under power.**
2. **Large cast iron conditioning rings are held in position and rotate freely on the lap plate . . . continually keeping the plate flat and true.**
3. **Work pieces are placed inside the conditioning rings where they also rotate on the lap.**
4. **Fresh, sharp abrasive grains, suspended in a suitable vehicle, are continuously fed on the lap plate and uniformly distributed under the work pieces during the lapping action.**



WHY THE LAPMASTER IS TRULY A PRODUCTION MACHINE

Identical parts or parts of various shapes, heights and materials can be lapped simultaneously on one machine.

Production is not interrupted or slowed down for replacing or reconditioning lap plates.

Simplicity of design with no obstructions makes loading and unloading easy and simple.

Exclusive design and method of operation with greater effective lapping area permits more loadings per cycle.

Short, predetermined lapping cycles are automatically controlled by a timing clock for greater production efficiency.

Automatic cycling permits pre-loading additional work holders while machine is in operation.

HOW COSTS ARE CUT...PRODUCT IMPROVED

These excerpts from letters sent in by actual Lapmaster users tell the story better than our own words.

"... never been a reject from the work performed on this machine."

"... gives us better quality with less scrap and reduced labor costs."

"... maintenance costs only approximately $85.00 whereas old method was costing approximately $8000.00 per year."

"... machine will save its costs in 2 years by salvaging the mechanical seals for us which would otherwise have been discarded."

"... have dispensed altogether with tests for leakage."

"... the Lapmaster has more than paid for itself—we've eliminated a finish grinding operation and save on expensive fixturing."

HOW DOWNTIME IS ELIMINATED

The Lapmaster is the only lapping machine that does not have to be stopped for redressing or truing the lap plate. Flatness of the lap plate is continuously maintained by the patented reconditioning action of the conditioning rings.

WHAT ABOUT PART SIZE AND SHAPE?

Standard machines in the Lapmaster Line will handle parts from ⅛" up to 30½". Shape or form is not a problem . . . tall or squat, long or short, flat or odd shaped . . . all are being lapped on Lapmasters throughout industry. Monel, steel, tool steel, bronze, cast iron, stainless steel, aluminum, brass, quartz, ceramics, plastics, etc. can all be lapped with the same lap plate.

OPERATOR NEED NOT BE EXPERIENCED

Unskilled operators can be used since the only manual work required is loading and unloading the pieces.

PROVE IT TO YOURSELF WITH THE LAPMASTER TECHNICAL SERVICE

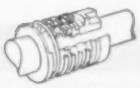
One sure way to find out if the Lapmaster can save you money is to send us samples and surface finish specifications of parts. We'll test run them in our experimental lapping laboratory and furnish you with a complete production report without obligation. Or write for FREE Booklets with complete facts on producing and measuring precision flatness and finish.

Crane Packing Co., 6469 Oakton St., Morton Grove, Ill. (Chicago Suburb).

In Canada: Crane Packing Co., Ltd., Hamilton, Ont.

John Crane


MECHANICAL PACKINGS


SHAFT SEALS

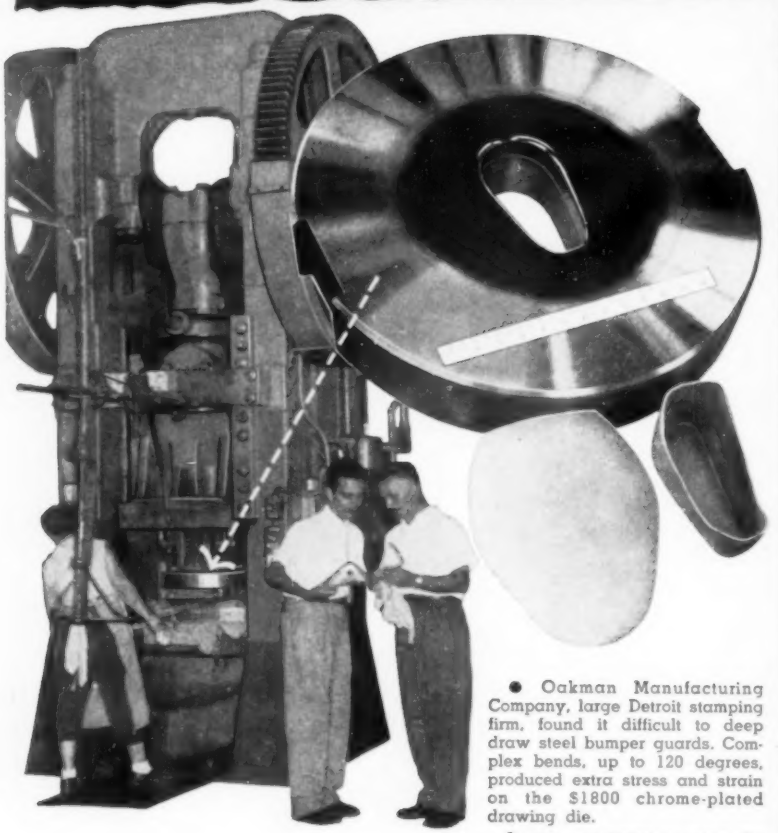

TEFLON PRODUCTS


LAPPING MACHINES


THREAD COMPOUNDS

CRANE PACKING COMPANY

TALIDE DIE SAVES OVER $20,000 DRAWING AUTO BUMPER GUARDS



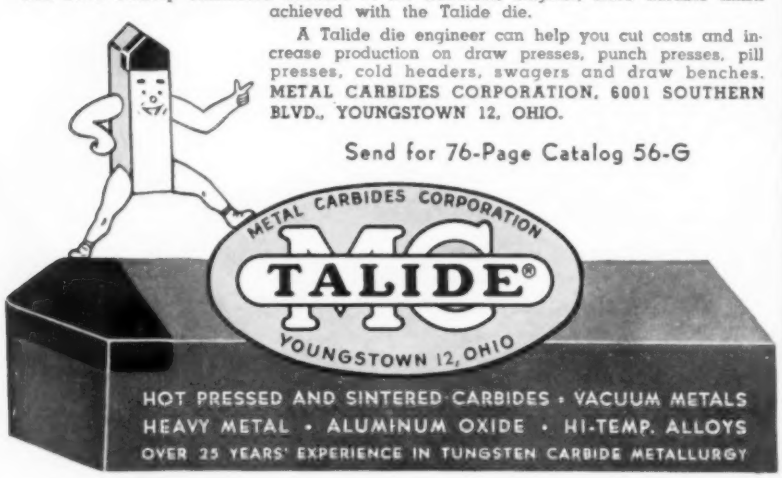
● Oakman Manufacturing Company, large Detroit stamping firm, found it difficult to deep draw steel bumper guards. Complex bends, up to 120 degrees, produced extra stress and strain on the $1800 chrome-plated drawing die.

It was necessary to stone the die surface every hour, and hand polish entire drawing surface after each day's run. The steel die had to be completely reworked and a new chrome-plated surface added after drawing 60,000 parts. Downtime for maintenance made it difficult to maintain production schedules. Maintenance costs soared.

A Grade C-80 Talide die ($2700) was installed 8 months ago. To date it has drawn over 800,000 guards with no wear in evidence. Downtime for die maintenance has been greatly reduced. A buffing operation (25c per piece), previously required, has been entirely eliminated because of the smoother, brighter, more durable finish achieved with the Talide die.

A Talide die engineer can help you cut costs and increase production on draw presses, punch presses, pill presses, cold headers, swagers and draw benches. METAL CARBIDES CORPORATION, 6001 SOUTHERN BLVD., YOUNGSTOWN 12, OHIO.

Send for 76-Page Catalog 56-G



SWAGING DIES

Leading Fountain Pen Manufacturer cold swages 33 times more stainless steel parts with TALIDE dies.

HEADING AND EXTRUSION DIES

Cold heading ¼" C-1008 rivets, TALIDE dies produced 11,200,000 pieces, other carbide dies only 3,500,000.

CURLING ROLLERS

TALIDE Curling Rolls last 65 times longer than steel rolls on beverage can forming operation.

BLANKING AND FORMING DIES

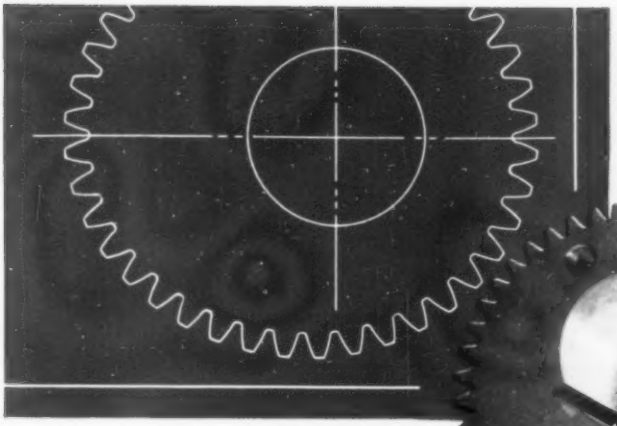
70 times more paper discs blanked out with TALIDE—over hard alloy die.

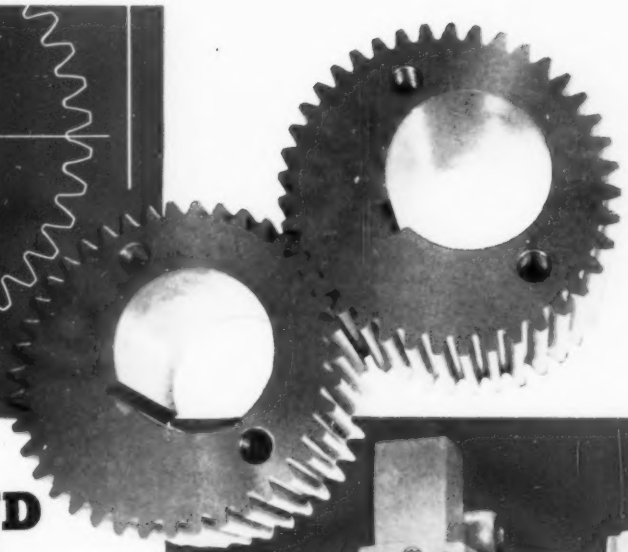
SHEET METAL DIES

137,000 hi-alloy steel pressure vessels drawn with TALIDE against only 7,900 with steel dies previously used.

POWDERED METALLURGY DIES

Compacting highly abrasive chemical powders, TALIDE pill dies last 4 months, steel dies wore out in 6 hours.



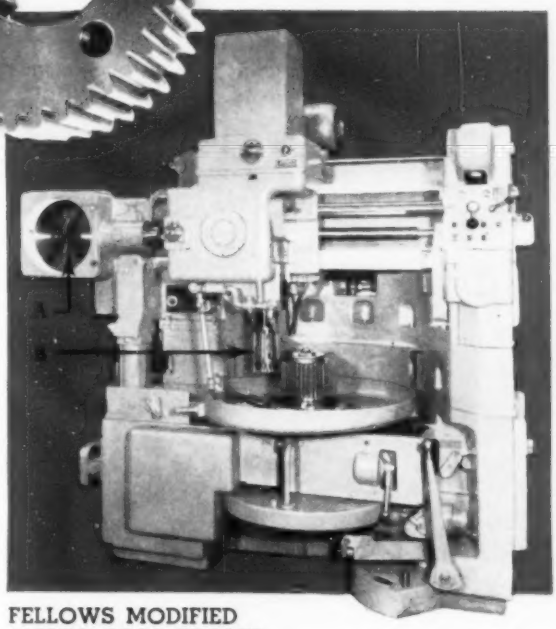


ELLIPTICAL AND OVAL GEARS

produced accurately and economically

Until now, owing to production difficulties, the design advantages of oval or elliptical gears have rarely been realized. Now Fellows has developed a unique method of generating these gears rapidly and economically. This new method minimizes the difficulty of wide variations in backlash experienced with such gears cut by previous methods. Full or modified involute teeth are produced to a higher degree of accuracy than was ever possible before on gears of this type. Production in any quantity is as simple as in cutting conventional cylindrical gears, once the setup has been made.

Fellows Modified 36-Type Gear Shaper generates elliptical or oval gears by continuously varying the center distance between cutter and gear during the cutting operation. A contour cam (A) and follower move the saddle the required amount in timed relationship with the rotation of the eccentric cutter-spindle adapter (B) to produce the gear pitch line contour.



FELLOWS MODIFIED 36-TYPE GEAR SHAPER

In addition to *oval and elliptical gears* up to a maximum pitch diameter of 18", the Modified Fellows 36-Type Gear Shaper can produce a remarkable variety of *irregular contours* at high production rates. Two cams, a cutter-spindle adapter and a cutter are required for each gear or other shape specification. For further information, get in touch with any Fellows office.

THE FELLOWS GEAR SHAPER COMPANY
78 River Street, Springfield, Vermont
Branch Offices:
1048 North Woodward Ave., Royal Oak, Mich.
150 West Pleasant Ave., Maywood, N. J.
5835 West North Avenue, Chicago 39
6214 West Manchester Ave., Los Angeles 45

THE PRECISION LINE

Fellows *Gear Production Equipment*

be a Profit prophet ...without Crystal Ball!

Users of U. S. Adjustable Drill Heads are unusually accurate in anticipating profit pictures— they regularly figure lower and *more dependable costs.* That's because these high-quality heads—priced right to start with—usually cost less to maintain, less to operate.

The U-1 Head shown has 8 drivers, ¼" drilling capacity in cast iron, 6" diameter drilling area. With 2 spindles and Erickson chucks, it costs only $260.

And that's because ALL U. S. Heads of this type have these plus features:

SHAVED GEARS for smooth, quiet operation.
SPECIAL UNIVERSALS with heat treated joints, neoprene sealed and lubricated for life.
ALUMINUM BODY CASTING with special 33,000 lb. tensile.
GREATER BEARING AREA for the spindles.
QUICK CHANGEOVER for different hole patterns.
SLIP SPINDLE PLATE, providing the advantage of a fixed center head on long runs.

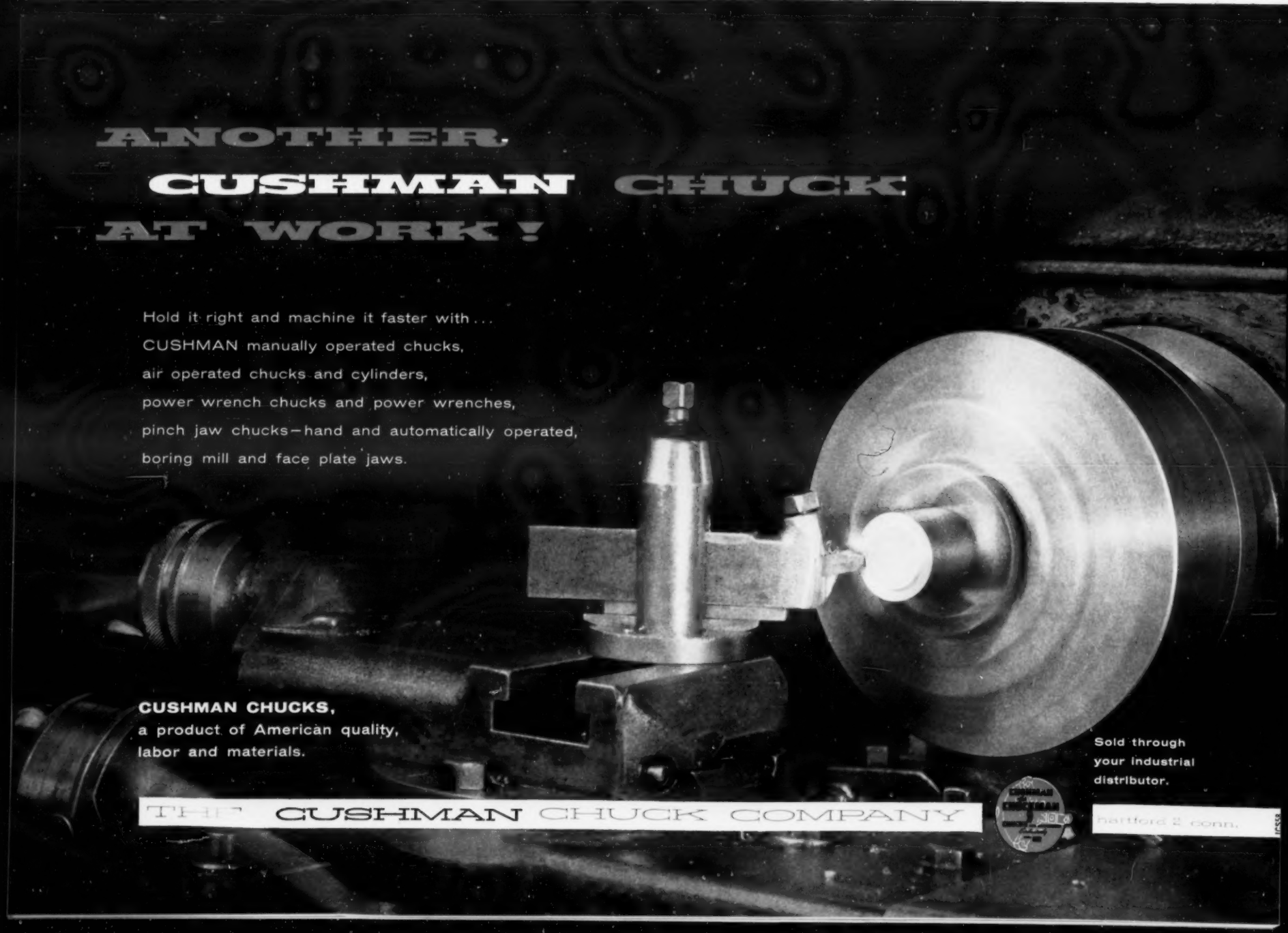
Write for catalog AD-57. Immediate delivery on most standard sizes.

Adjustable and Fixed Center Multiple Drilling Heads
Individual Lead Screw Multiple Tapping Heads

US DRILL HEAD

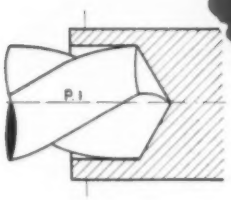
UNITED STATES DRILL HEAD CO.

BURNS STREET • CINCINNATI 4, OHIO

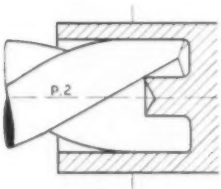

ANOTHER
CUSHMAN CHUCK
AT WORK!
Hold it right and machine it faster with...
CUSHMAN manually operated chucks,
air operated chucks and cylinders,
power wrench chucks and power wrenches,
pinch jaw chucks—hand and automatically operated,
boring mill and face plate jaws.
CUSHMAN CHUCKS,
a product of American quality,
labor and materials.
Sold through
your industrial
distributor.
THE CUSHMAN CHUCK COMPANY
hartford 2, conn.

Produce Parts Like This In One Operation with BECHLER SWISS AUTOMATICS

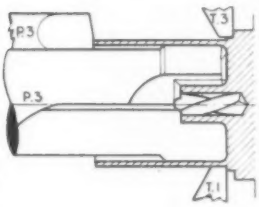
Material: Aluminum



1 Rough drill–turret pos. 1.

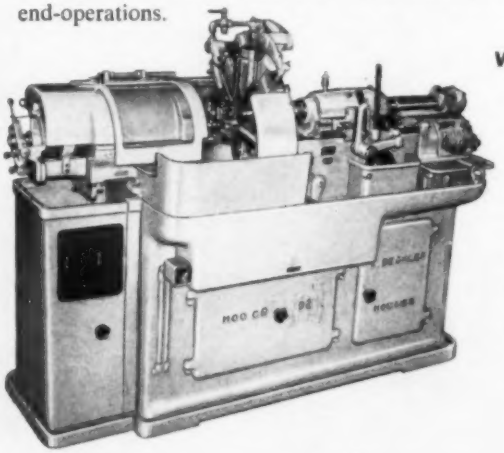


2 Rough trepan–turret pos. 2.



3 Finish trepan, drill, face-off–turret pos. 3; rough turn O.D.–tools 1 & 3.

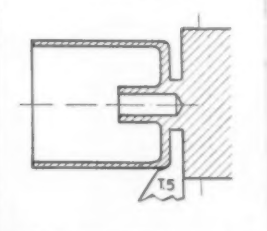
A Bechler CR-32 produced this intricate part from bar stock *in one operation*. Results were typical of Bechler performance: turning tolerances were held within .0005″, concentricity to .0005″, wall thickness within .0003″. Improvement over a previous multi-operation method was outstanding – lower costs, fewer rejects and a better finished product. Production of such parts is relatively simple with the Bechler's unique features – 5 cross slides (T) for the famous Swiss method of single point turning with carbide tools, 6 turret stations (P) for intricate, multiple end-operations.



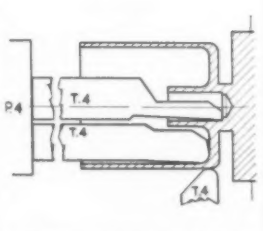
Write for Further Details

Bechler Model CR-32

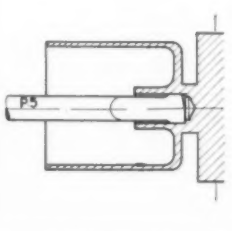
1¼″ diameter capacity • 9″ maximum turning length • gear driven headstock • 5 micrometer controlled cross slides • 6-spindle turret with hydraulic indexing.



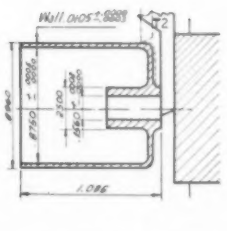
4 Rough cut outside end–tool 5.



5 Finish turn O.D. – tool 4; bore large & small I.D.'s – boring tools controlled by turret pos. 4.



6 Ream small bore–turret pos. 5.



7 Finish outside end (generation) and cut-off–tool 2

COSA — *nationwide sales and service of precision machine tools —from bench lathes to boring mills.*

COSA CORPORATION, 405 LEXINGTON AVENUE, NEW YORK 17, N.Y.

Service: – Bechler Service Corporation – 28 Harbor Street, Stamford, Connecticut

In Canada Contact Cosa Corporation of Canada, Ltd. 1160 Lakeshore Road, Long Branch, Toronto 14, Ontario

Stuart

Productive Lubrication

FOR PROFIT-MINDED PRODUCTION MEN

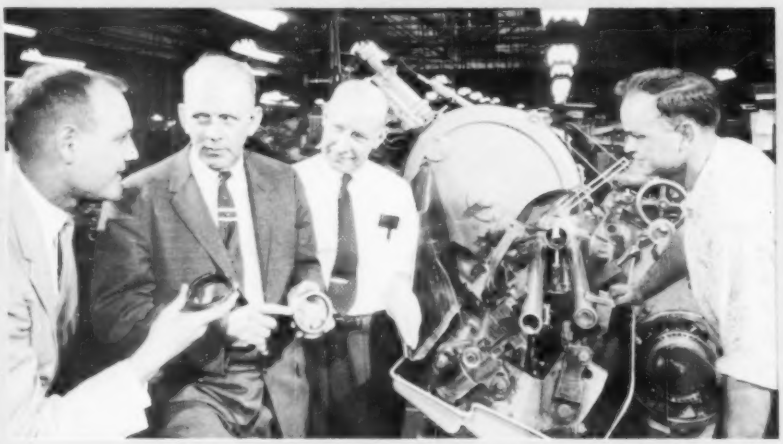
VOL. 1, NO. 1 NOVEMBER 1958

High-lubricity soluble oil helps Bower grind better bearings faster

Stuart's free-cutting Dasco super soluble hikes production. Fine finish trims honing time.

Experience at Bower Roller Bearing Division, Detroit, proves some interesting points about cutting fluids for grinding 52100 steel.

Stuart's Dasco super soluble base is used in Bower's central system at 30:1 for grinding cups and cones for all types of tapered and straight roller bearings. It helps attain surface finishes up to 20 microinches, reducing the amount of honing required. In addition, Dasco super soluble contributes other important advantages: decreased cycle time per piece, reduction in annoyance of rancidity, and longer solution life than with other cutting fluids tested. Vapor and dirt are reduced.



Stuart's John S. Dalton, with Spike Dunaway, general grinding foreman, and William Hoff, both of Bower, solved a difficult grinding problem on tough bearing steel with Dasco super soluble base.

Answer to Stress-Free-Grinding

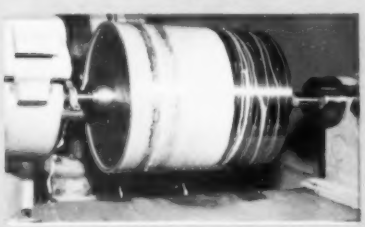
Tolerances at Bower as close as .0005 in. on both OD and ID are not unusual and even closer limits are required on some jobs. Extra-high detergency and free-cutting action are just as vital as cooling to prevent heat-checking, loss of accuracy due to heat distortion, and costly downtime for wheel dressing. Wheel grits vary from 60 to 120, and some wheels may cut up to 1000 pieces before dressing.

Excellent Automation Cutting Fluid

In this shop, which works two-shift operation, Dasco super soluble helps increase production when used in a central system serving over 100 different grinding machines because downtime for maintenance, clean-out, and recharging the machines is at a minimum.

Dasco super soluble base is a compound formulated for metal-working operations too difficult for ordinary water-mix fluids, yet not suited for straight cutting oils. It has a sulphochlorinated fatty oil base, which provides an excellent combination of antiweld and lubricating properties for turning, drilling, milling, sawing, boring, and reaming.

CODOL proves versatile on fine-finish job



Finish grinding IBM's all-important "memory unit" (above) dramatically illustrates the versatility of Stuart's Codol liquid grinding compound. The 10-in. OD monel drum rotor is coated with copper and final-plated with a cobalt-nickel outside coating that retains and categorizes all information from the data-processing machine. Dirt, scratches, or dimensional inaccuracies could cause serious errors. Each coating is precision ground using Stuart's Codol to lubricate and keep the wheel clean. About .008 in. is removed in each step, and concentricity is held within .00025 in. Codol's extreme cleanliness is most important, followed by cooling efficiency, and carefully balanced surface tension that floats away "chips" to prevent scratches.

MORE PL FACTS ▶

Stuart Productive Lubrication

Low tool lubrication cost a danger signal

Any cost which looks low and stays low could be a "booby trap" and should be re-evaluated periodically by production management.

This does not imply that a higher cost for a cutting fluid necessarily gives you the best combination of qualities for a particular job. Sometimes the low-priced product outperforms the higher priced product. But, there is a basic fallacy in purchasing and budgeting practice today which often defeats your purpose of profitable operation, particularly with today's lower volumes. Here's what we mean.

In a very few instances can a cutting fluid be considered a machine maintenance item, or cost, or an overhead burden to be allocated by department in relation to its consumption. If the cutting fluid doesn't protect the cutting tool, you're better off machining your pieceparts dry.

Thus, "tool lubrication cost" is as integral a part of tool replacement cost as the cutting tools, resharpening, and downtime for changing and resetting tools.

COST (per week)	Cutting Fluid "A"	Cutting Fluid "B"
1. Tool changing cost	$ 1.20	$ .30
2. Tool regrinding cost	$239.40	$59.85
3. Tool depreciation cost	$145.00	$36.25
4. Tool lubrication cost	$ 1.77	$ 1.89
Total tool replacement cost	$387.37	$98.29
1. Tool replacement cost per piece	$ .32	$ .08
2. Machining cost per piece	$ .24	$ .20
Total cost per piece	$ .56	$ .28

Determine your tool lubrication cost per piece (along with your other tool replacement costs) and you will find it so small that only performance really counts.

Cost of cutting fluid is not always in the price. Here's why. In one case studied, a 12c a gallon "higher price" increased the number of pieces per sharpening 300%, reducing the average number of tool regrinds 75%, and the number of new tools required was reduced 95%. This improvement cut tool replacement cost from $387.37 to $98.29 per week—all for an added expenditure of just 12c a gallon for an improved type of cutting fluid.

An annual increased investment of $6.24 to get an improved quality product yielded a yearly saving of $15,032.16.

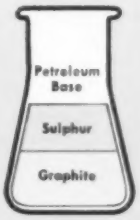
The chart illustrates the economies inherent in cutting fluid evaluation. On this job with tool replacement cost reduced from 32c to 8c per piece, the manufacturer could afford to increase machine speed from 720 to 980 ft per min. The part cost was slashed from 56c to 28c — a 50 per cent cost reduction.

Advantages of THERMEX compounds stand out on tough valve forging job

High lubricity solves galling and welding problems, low burning rate protects operator

Galling and welding are eliminated in the plant of one of the automotive Big 3 by using a spray application of Stuart's Thermex "CMF"

forging compound to produce 3800 exhaust valves per eight-hour shift with manual load and unload and 10,000 V-8 intake valves per shift automatically. Out of a full-shift production of over 38,000 exhaust valves, only 3.7 per cent were rejected. On another run of 24,260 valves, rejects were only 2.25 per cent, and on a third run of 15,893 V-8 valves, rejects dropped to 1.55 per cent.



The plant's general superintendent reports Thermex "CMF" has a lower burning rate after the initial flash, making it ideally suited for insert die valve forging . . . particularly on the automatic machines

operating at 40 per cent greater stroke capacity. Other forging compounds burned with increased intensity or continuity, creating difficult working conditions.

The answer is a high graphite content in the lubricant. Thermex "CMF" has a high percentage of graphite, contains active sulphur to eliminate galling and welding, and provides efficient lubrication under the high temperature operating conditions of this forging operation.

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METALWORKING LUBRICANTS
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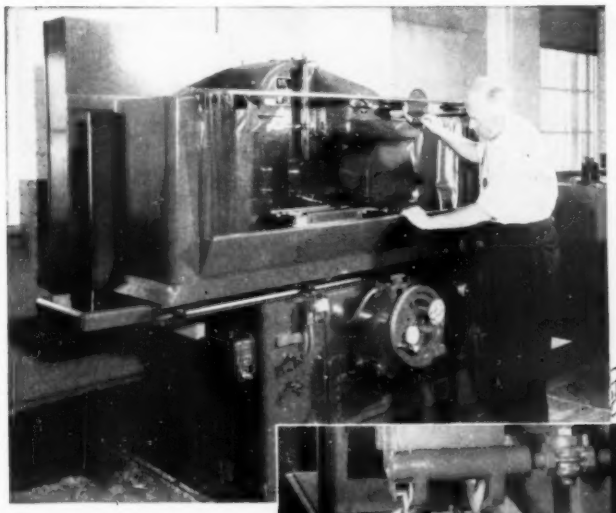
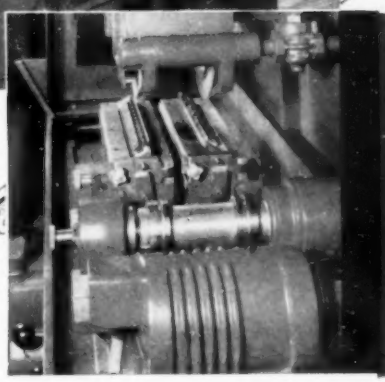
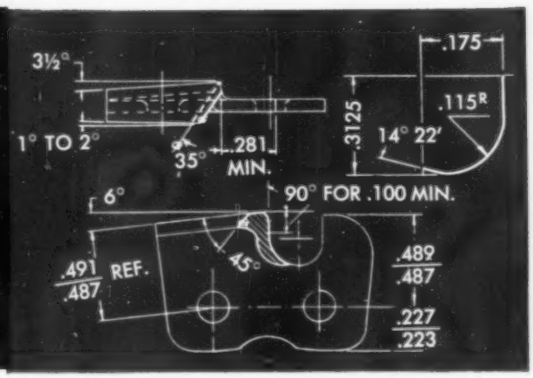
Thompson — TRUFORMING CUTS COSTS 60%







For 140 years, the policy of The Draper Corporation of Hopedale, Mass., has been to offer the highest quality product at the least possible cost.

Following this policy, its subsidiary, BlueJet Corporation, manufacturers of the famous BlueJet saw chain, installed a Thompson Truforming grinder to grind the cutting edges on their chain saw routers. These routers were formerly ground, piece by piece, by a force of 8 employees.

The Thompson Truforming operation is now cutting former grinding costs by 60%. 3 men only are now required for the operation. 40 L.H. and 40 R.H. routers are now ground simultaneously with one pass of the crush formed wheel, resulting in a day's production of over 12,000 pieces—many times that produced by the former method. Both the uniformity and sharpness of the routers have been greatly improved.

For 25 years, Thompson has pioneered and developed the modern advances in crush form grinding. If you have a time-saving, product-improving or cost-cutting problem in your operations, it will pay you to investigate the work Thompson Truforming grinders are now doing in plants all over the country. Our engineering experience is available to you without obligation. Write for Catalog T558.

"Keep Thompson in mind for the daily grind"

THE THOMPSON GRINDER COMPANY

SPRINGFIELD, OHIO

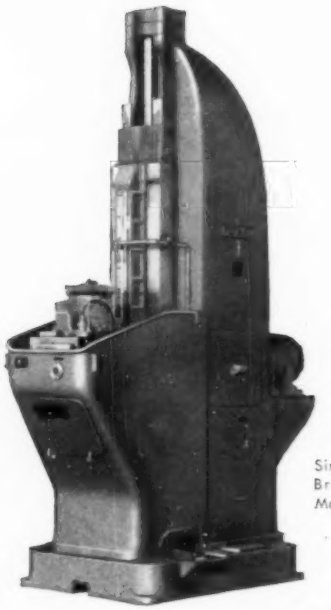
Thompson SURFACE GRINDERS

FOOTBURT

a faster

MORE ECONOMICAL

machine operation



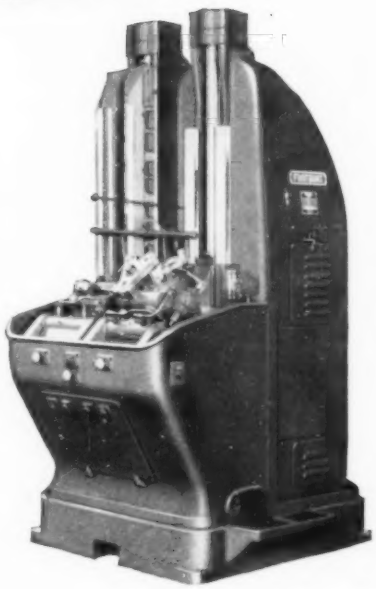
Single Slide Surface Broaching Machine. Made in 5, 10, 15 and 25 Ton Sizes.

Footburt Surface Broaching may be the answer to your problem of faster machining. Many jobs that were slow and expensive when handled by conventional machining methods are now being produced by Surface Broaching. Production in most cases is as fast as the speed at which parts can be loaded. Yet cutting speeds are so low that the cost of tool maintenance shows great savings. Exceptional finish can be maintained. We will gladly discuss your machining problems with you.

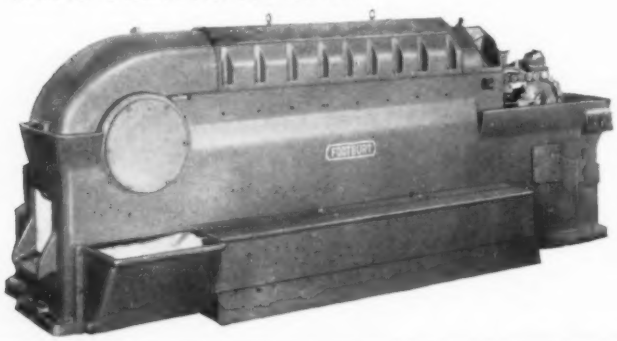
THE FOOTE-BURT COMPANY

Cleveland 8, Ohio Detroit Office: 24632 Northwestern Hwy., Detroit 35, Mich.

Write for Circulars No. 503 and 509



Duplex Surface Broaching Machine. Made in 5, 10, 15 and 25 Ton Sizes.



Continuous Type Broaching Machine. Made in 5 Sizes.

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PIONEERS IN SURFACE BROACHING

Exactly the Carbide Tool You Need . . .

and every tool in the full line gives you superior Staples quality

Staples quality, product of more than 20 years experience in the manufacture of carbide-tipped and solid carbide tools, is your best assurance of fast, accurate and economical cutting. The complete range of types and sizes provides a stock tool for almost any requirement.

- **EXPANSION REAMERS:** 8 styles
- **SOLID REAMERS:** 12 styles
- **TWIST DRILLS:** 6 styles
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48-HOUR SERVICE—Send us your order. Upon request we will ship, within 48 hours, stock carbide reamers and core drills ground to your specified diameters.

"SPECIAL" CARBIDES, TOO—Prompt quotations on special carbide tools made to your specifications by skilled Staples craftsmen.

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ROTATING CARBIDE TOOLS

THE Staples TOOL COMPANY

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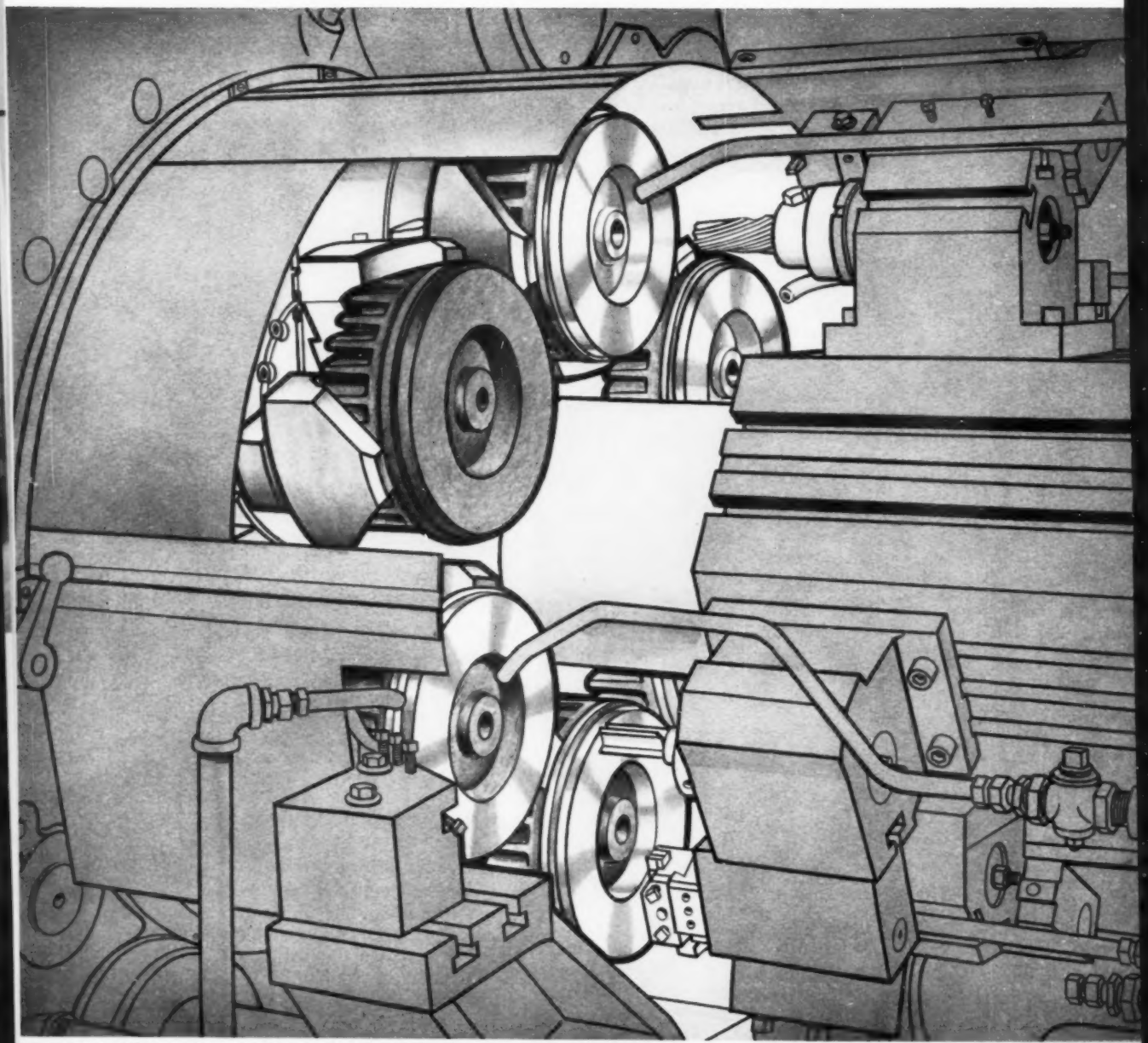
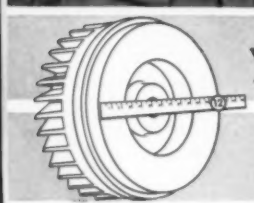
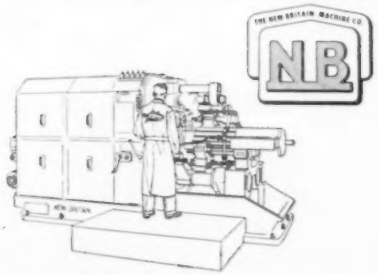




yes! you can put it on a New Britain

Now the larger pieces which formerly necessitated slower methods because of their size can be turned out at lower cost. You can, for the first time, apply New Britain standards of productivity to larger work with the *new* New Britain four-, six- and eight-spindle chuckers . . . new, larger chucking capacities (up to 15 inches), with spindle speeds, power and ruggedness to match, and all the exclusive New Britain advantages. The New Britain Machine Company, New Britain-Gridley Machine Division, New Britain, Connecticut.

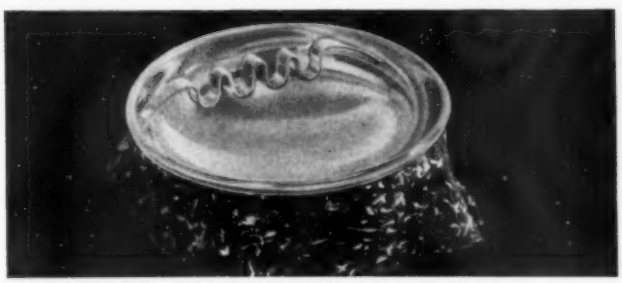


Automatic Chucking Machine

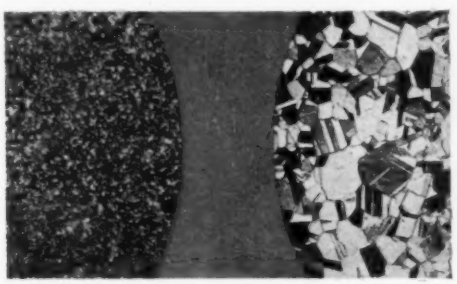
NEW BRASS SPEEDS FINISHING operations for Park Sherman Co.—Formbrite, Superfine-Grain Drawing Brass by Anaconda, reduces polishing time—cuts cost up to 50%—gives clean, easy formability.

TO THE PARK SHERMAN CO., Springfield, Ill., finishing operations are important in giving its line of fine brassware sales appeal—are also weighty cost factors. Switching from ordinary drawing brass to Formbrite, Park Sherman boosted production on the tray of this "Merry-Go-Round" Bar—25% in the cutting operation—42% in finish buff.

THE COVER of this Park Sherman Silent Butler is now made of Formbrite, Anaconda's Superfine-Grain Drawing Brass. Polishing operations in preparation for chromium plating are 50% faster than with ordinary drawing brass.



PRODUCTION INCREASED 47% in finishing operations on this Park Sherman Sta-Put ashtray after the shift to Formbrite. Products shown are only three of many Park Sherman products now made of Formbrite.



THE SECRET of Formbrite's superior polishing characteristics is its superfine-grain. Micrographs (75X): left, Formbrite; right, ordinary drawing brass.

Wherever finishing is an important cost factor in formed or drawn products, Formbrite in sheet and strip is designed to save you money. In brass wire alloys for cold-heading and upsetting, it gives a stronger, springier, more abrasion-resistant product. For more detailed information, write for Publication B-39. Address: The American Brass Company, Waterbury 20, Conn. In Canada: Anaconda American Brass Ltd., New Toronto, Ont.

5948

FORMBRITE®

SUPERFINE-GRAIN DRAWING BRASS

a product of

ANACONDA®

Made by The American Brass Company

Why not measure cutting speeds in dollars saved?

Higher machining speeds, preset and quick-change tooling offer you real cost-cutting opportunities

If all your cutting tools were suddenly less expensive, you could afford to increase machine speeds, couldn't you?

When you stop to examine the facts, by far the highest elements of tool cost are downtime for changing tools, in-the-machine adjustments, and sharpening costs. Often, they are more than 10 times the actual cost of cutting tools consumed. Now, Scully-Jones offers you a way to reduce these costs substantially so that it will pay you to increase cutting speeds, giving you maximum return on the investment that really counts —*your machine tools.*

Formula for determining least cost

"Optimation" is the popular name for the technique of obtaining *least cost* per piece (not lower tool cost) and it's easy to put to work on your large automatics. In plants where it is being used, cut-and-try scrap has been reduced, machine speeds have been increased, and productive machine time has been extended—all for a minimum investment in tooling. To make it work, you need:

1. Preset, quick-change tools
2. Programmed tool changes

You can get the equipment to meet both requirements, plus the experience needed to apply it from Scully-Jones.

To start, we help you figure optimum feeds and speeds for the tools that limit the machine cycle. They are based on minimum-cost tool life. You don't have to worry if tool changes are needed more often because your machine is being operated at maximum efficiency and besides, tool change time is only a matter of seconds per tool. For example, 9 tools on a 6-spindle Conomatic were changed *in 5 minutes and 40 seconds* compared to 42 minutes and 35 seconds with conventional toolholders.

Fig. 1—Scully-Jones "Toolitrol" board is the complete way to put a tool control system to work. Counters keep track of parts produced by each work station. Preset tools are stored in the board, ready to insert in the machine with no cut-and-try adjustments.

Easy way to set efficiency standards

An important part of the "optimation" story is the fact that tools are preset outside the machine while the machine is producing with another set of tools. Operators who are on incentive like it. Cut-and-try methods are eliminated, and you get the same high efficiency from every operator in your shop.

But even more important, the outstanding accuracy made possible by using presetting tools and fixtures means your cut-and-try scrap loss will be minimized. From the first cut after a tool change, you are producing parts to required specifications.

Control wear below breakdown point

Everyone recognizes that tool wear is accelerated after a certain number of pieces is produced. You can guard against excessive dulling of tools and off-limit parts by using "Toolitrol" boards equipped with Scully-Jones impulse counters. These boards are a storage center for replacement tools, with a worktable for presetting. And the counters give you a true picture of the number of parts produced by each tool. Replacement *in time* not only reduces scrap but guarantees more resharpenings per tool, plus lower sharpening costs.

You can't meet today's competitive costs with yesterday's thinking or tools. Higher cost machines and higher labor rates make it mandatory to minimize nonproductive machine time and keep machines producing at a more efficient rate.

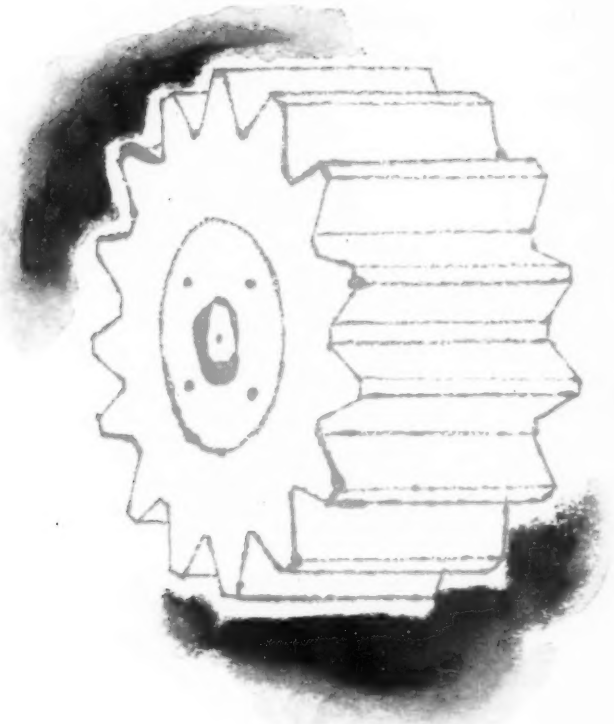
Fig. 2—Standard "Optimation" preset and quick-change holding tools are available for large automatics, designed for front or back removal from tool slides. Tooling makes every operator as proficient as the most experienced setup man.

Want more information?

Free literature describes how "optimation" is applied, typical results that have been achieved, and forms for analyzing minimum cost tool life. Write to: Scully-Jones and Company, 1915 South Rockwell Street, Chicago 8, Illinois.

Fig. 3—"Optimation" quick-change chuck with preset adapters. Tools are preset outside the machine by turning the knurled nut on the adapter, using a height-setting tool.

SCULLY JONES **PRECISION HOLDING TOOLS**



Gears... Cutting Oils... and How to Save Money

The more gears your equipment can hob before tool change, the lower your cost of operation. Sinclair Ordnance Cutting Oils have earned the reputation for increasing tool life because of their high heat dissipation characteristic. Furthermore, a special E. P. agent assures the highest quality finish . . . more money saved through fewer rejects. Switch to Ordnance, now. Next time management asks how you've cut costs, tell them you've changed to Sinclair—and show them the results.

Call your Sinclair Representative for further information or write for free literature to Sinclair Refining Company, Technical Service Division, 600 Fifth Avenue, New York 20, N. Y. There is no obligation.

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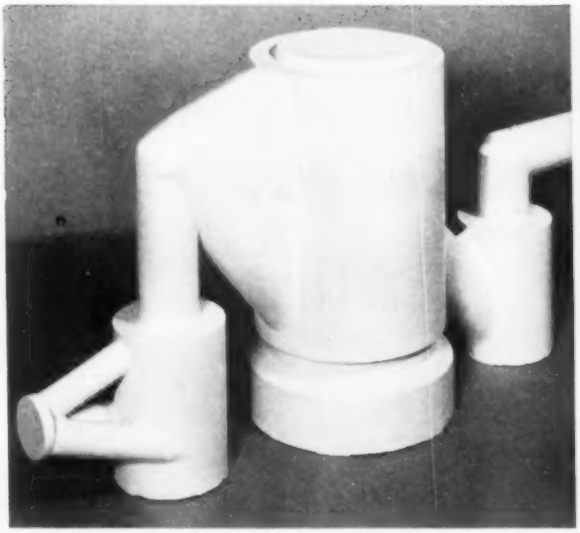

To shape the inside of the bromide-bromine liquor pump block, a form is made of plaster of Paris and Styrofoam®.

Dow Epoxy Resin 331 (casting formulation supplied by Ren Plastics, Inc.) is poured over the form and hardens.

The plaster of Paris and Styrofoam material in the form is broken up and removed.

Main part of bromine pump is installed, ready to operate without wear or corrosion!

Dow Epoxies help stop corrosion for chemical processors

This corrosion-free pump block adds another to the list of success stories made possible by new, pure Dow Epoxy Resins.

For years the main parts of bromide liquor pumps have been made with machined soapstone. Performance was inconsistent; the slightest crack or seam proved disastrous. But now Dow Epoxies open a new era of efficiency and economy for the chemical processing and corrosion fields. Easily cast to shape without costly machining, the epoxy pump blocks are impervious to the chemicals involved and free from the internal flaws of soapstone.

Have you a corrosion problem where Dow Epoxies may help? Write for information and technical help. Dow is a basic producer of the raw materials used in epoxy production. In this way Dow provides raw materials with optimum properties to produce superior resins, to control quality carefully and to provide a narrower range of specifications in the finished resin—so necessary to uniform performance. For complete information and technical data on Dow Solid and Liquid Epoxy Resins, consult your Dow sales office. Or write THE DOW CHEMICAL COMPANY, Midland, Michigan, Coatings Sales Department 2265M.

EPOXY T.M.

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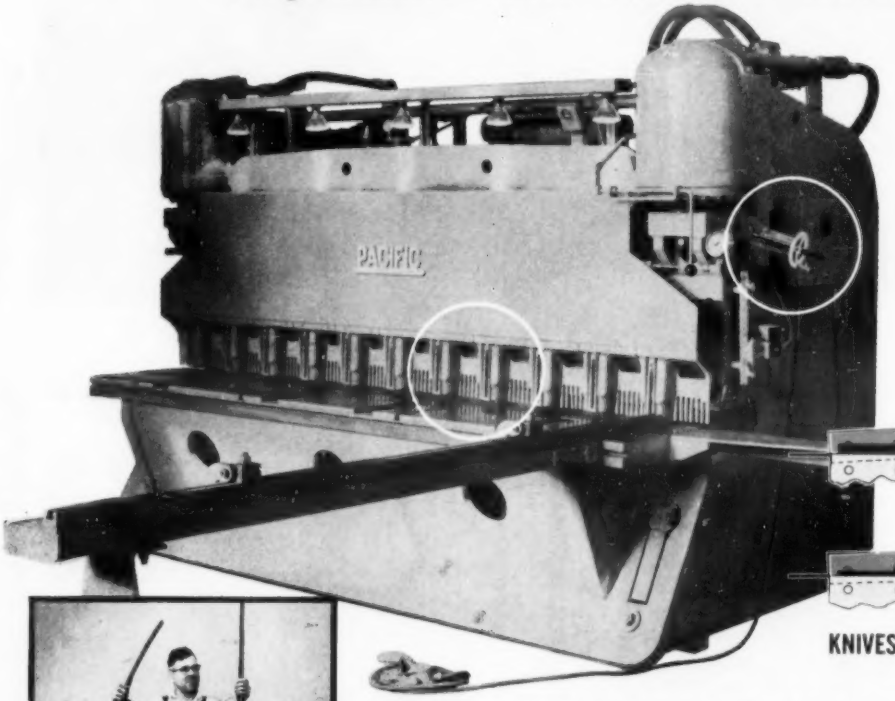
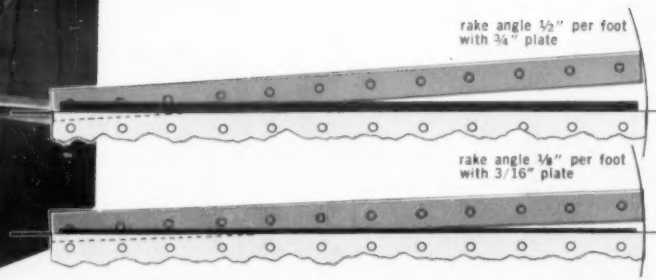
Adjustable rake PACIFIC HYDRAULIC SHEAR...

the single shear that produces highest quality cuts on both light and heavy metals.





Rake angle adjustable to match plate thickness

KNIVES STAY SHARP UP TO A YEAR OR MORE OF CUTTING 8 HOURS A DAY

Cuts up to 60 strokes per minute with minimum twist, bow and camber.
Left, ¼" plate cut with maximum rake angle. Right, ¼" plate cut with minimum rake angle.

Adjustable rake Pacific does the work of 2 or 3 conventional shears. It saves capital investment, valuable floor area and costs less to install. Heavy duty Pacific pays for itself out of operational savings . . . it takes fewer hands to operate, makes better cuts, requires little or no maintenance, virtually eliminates production downtime.

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For steelcutting . . . trim costs with Carboloy® Extra-Performance Grades 330, 350, and 370, and low-cost, General-Purpose Carboloy 78 and 78B carbides

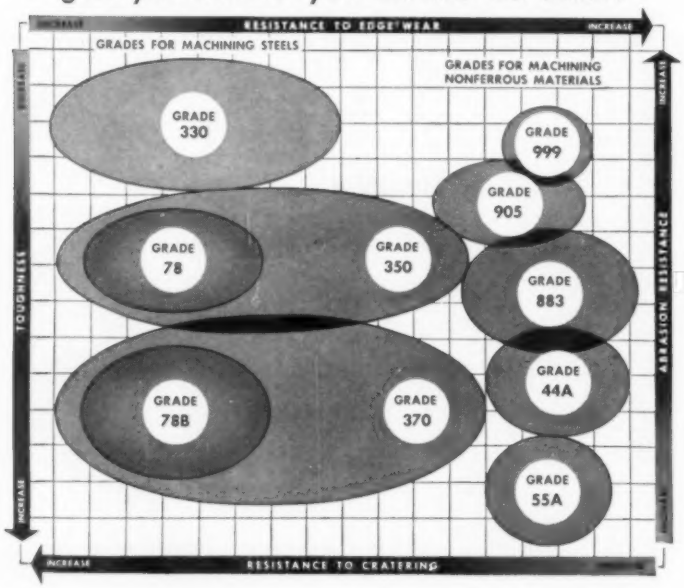
Some steelcutting jobs call for extra-tough, extra-performance carbides. Others can only be handled profitably with low-cost, general-purpose carbides. That's why we make them *both*.

Where you need increased machine productivity and have long production runs to keep cost-per-piece low—use Carboloy Extra-Performance Series 300 carbides. Their added strength and stamina handle jobs ranging from heavy roughing to high-speed finishing . . . at a unit cost and rate no "premium" carbide on the market can beat.

But, for general-purpose steelcutting jobs that don't require the Extra-Performance carbides, use Carboloy Grades 78 and 78B. Their top-notch performance, at low initial tool cost, will keep your machines operating profitably.

Chances are, your plant should be using *both* grades. Your local Authorized Distributor of Carboloy cemented carbides can deliver tools, blanks and inserts you need . . . in a hurry.

This complete team of Carboloy cemented carbides gives you more for your carbide tool dollar!



YOUR CARBIDE TOOL DOLLAR?

For nonferrous materials . . . boost production rates with Carboloy® cemented carbides performance-matched to your machining jobs

Aluminum, titanium, super alloys, wood—all have machining peculiarities that raise cain with production schedules and tool costs. That's why we make *five* job-tailored Carboloy cemented carbides for cutting these materials.

With these five grades (see chart, at left), you can get the one with exactly the right combination of shock resistance and wear resistance to match your job—whether heavy, interrupted cuts, or precision finishing.

Because you're using performance-matched carbides with consistent metallurgical quality, you can schedule heavier production loads . . . and you will get this increased output at lower tool-cost-per-piece.

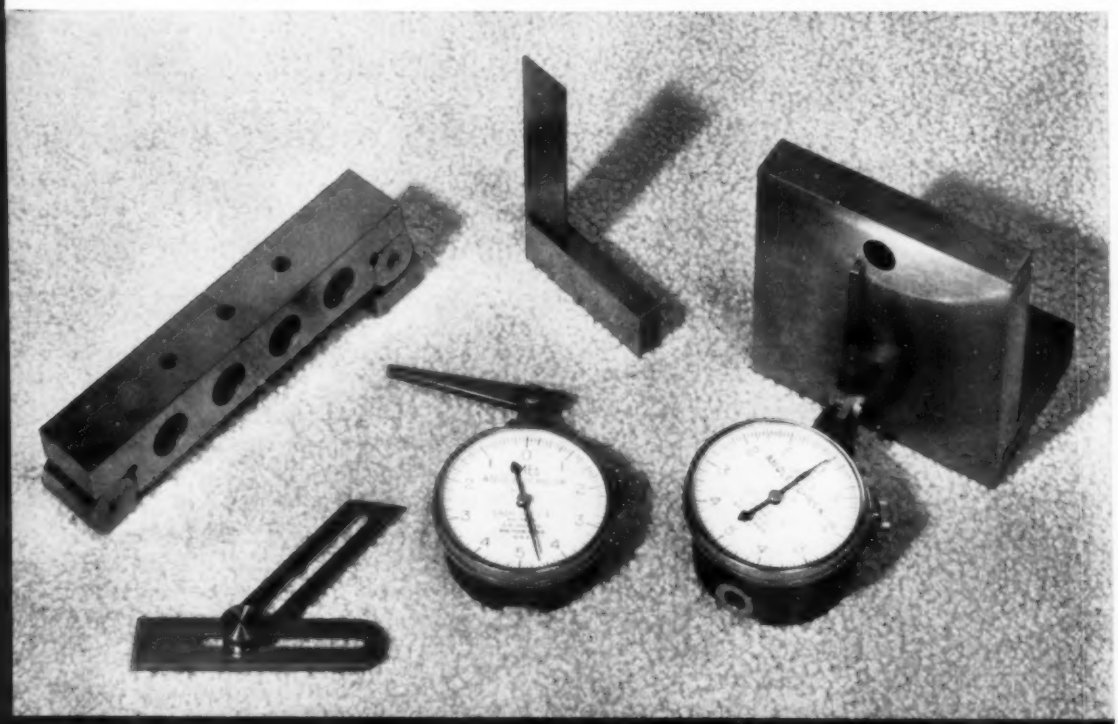
Your local Authorized Carboloy Distributor has complete stocks of tools, blanks, and inserts in these five grades. A phone call to him today will get your machines humming faster tomorrow.

For more information on Carboloy Extra-Performance and General-Purpose carbides, or nonferrous material carbides, write: Metallurgical Products Department of General Electric Company, 11101 E. 8 Mile Road, Detroit 32, Michigan.

CARBOLOY®
CEMENTED CARBIDES

GENERAL ELECTRIC

Check Angles Quickly and Precisely with the New



AMES DIAL TYPE ANGLE CHECK®

ANGLE CHECK, a new dial type measuring instrument, offers you a fast, inexpensive and extremely accurate method for checking all types of angular parts.

ANGLE CHECK is available in two models: Model V for vertical work and Model H for horizontal. Either model will accommodate any AMES 200 Series back. Contact blades can be specified in various shapes and lengths to meet your exact requirements.

Built to give long, trouble-free service, ANGLE CHECK will save hours in checking predetermined angles on simple and intricate shapes. Set ANGLE CHECK to master, protractor or sine bar.

The contact blade can be set simply and quickly without tools to a predetermined angle with the dial "0" under the indicator hand. A range of 10°—from 5° minus to 5° plus—in increments of 5′ can be obtained. ANGLE CHECK is accurate to 5′. Write today for complete information.

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MANUFACTURERS OF MICROMETER DIAL INDICATORS AND GAUGES

TWO *New* STARS on the *Super* STAGE

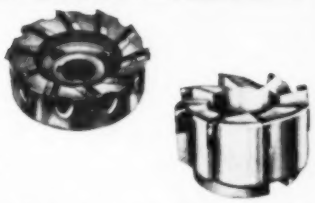
Brilliant Performers Join the Original Carbide Tool Line

New solid carbide single flute countersink #CS and center lap #CL.

Solid carbide flute section increases rigidity, eliminates chatter. Sharpening is by face grinding only. #CS has 82° taper, #CL has 60°. Available in ⅜", ½", ¾" diameters, all ¼" shanks. #CS available to order with 60° taper.

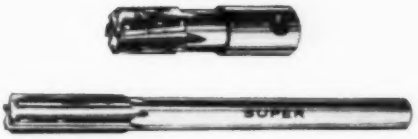
Instead of usual carbide tipped flutes, solid flute section provides much greater strength, less chatter, longer cutting life, less danger of breakage. Costs less than full length solid carbide construction. #RCS, fractional sizes ¼" to ¾". #RCB, decimal sizes .230" to .760", ground to specifications.

New straight shank carbide chucking reamer, #RCB and #RCS, with solid carbide flute section.



Milling cutters now in stock with premium carbide grades.

Standard and special carbide single point bits —turning, facing, threading, boring.



Reamers, all types. Stub screw machine and carbide tipped shown.

Carbide tipped and solid carbide twist drills, straight and tapered shanks, every type and purpose.

End mills, straight and spiral flute, solid and carbide tipped; for aluminum, iron, steel and other materials.

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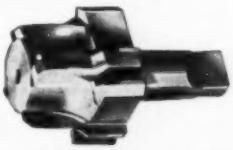

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Many Thanks

As Americans, we have an obligation to count our blessings and be thankful at this time of year. Indeed, it is a privilege for most of us to do so.

We may recognize our blessings and give thanks much more frequently than once a year, but Thanksgiving Day, established by the tradition of centuries, gives us special incentive to meditate and appraise their importance to us.

Perhaps it is helpful to spell out our blessings, in black and white. I, for example, am thankful for:

A sound mind and body.

The love and affection I bear for my family and friends, and the harvest of devotion received in return.

The privilege of serving my God and my country.

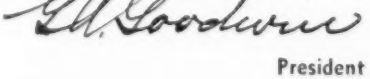
The freedom of speech and action symbolic of the American way of life with its many rewards.

The foresight and fortitude of those who had the courage to organize the American Society of Tool Engineers.

The Society's growth, expanding prestige, educational opportunities and cooperative fellowship accruing to every tool engineer who avails himself of these benefits of membership.

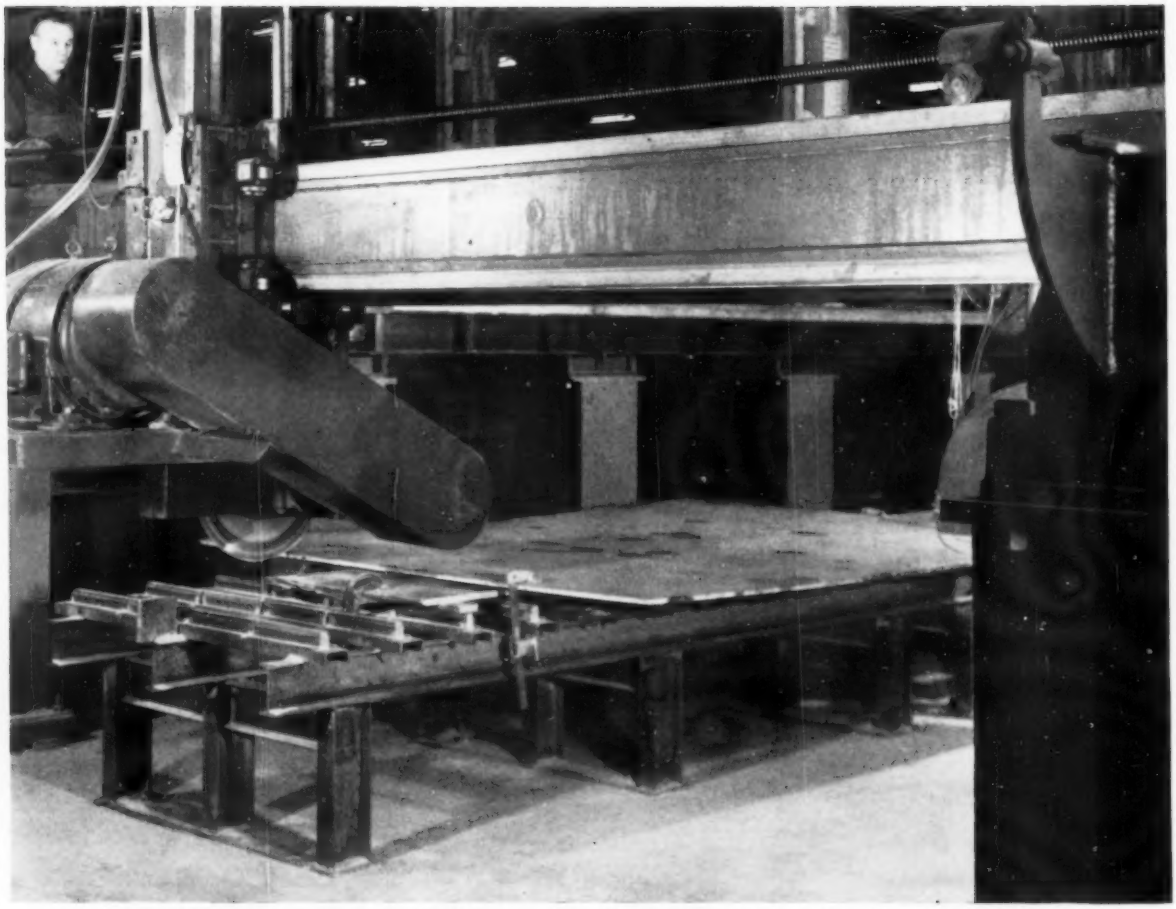
The loyal support and personal sacrifice of the National Officers, Directors and Headquarters staff who have faithfully served with me in months past, and the dedicated effort by committee members and chapter officers which has made ASTE what it is.

I hope this greeting will inspire every member to count *his* blessings too.



President

American Society of Tool Engineers



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putting ideas to work

By James A. Houle
Rubber & Asbestos Corp.
Bloomfield, N. J.

"Imaginitiative"—imagination with muscles—can be developed by anyone, according to the author, who shows how many engineers have developed their creative potential and successfully solved manufacturing problems in their plants.

From a talk presented to the Saginaw Valley chapter.

CREATIVITY—the ability to generate constructive ideas and put them into effect—is often considered to be a talent possessed by only a few fortunate individuals. Actually, however, every individual has creative talent. The difference between a creative engineer and a noncreative engineer is simply in how that talent is applied.

Filling A Need

Most engineers find it difficult to think creatively because they can't find a starting point. The best way to get started, according to Marvin Small, a man who successfully practiced what he preached, is to find a need and fill it.

Creative engineers make a habit of looking critically at jobs that are being done poorly. They are never satisfied with things as they are. They are convinced that there are always ways of doing a job better.

In every plant, there are operations or departments where costs are too high, production is lagging or there is a high scrap rate. These are the areas where the need for creative ideas is obvious.

Having found problem areas, the first step is to get all of the facts so that the real problem can be understood. This requires concentrated effort, not mere "brainstorming." Often, when all of the facts are recognized, the solution is obvious.

Once the problem is known, the next step is to think of how the needs can be met. Relatively simple ideas often save large sums of money. An Eastern manufacturer, for instance, discovered that his company could save $220,000 a year in freight and crating costs by using spruce, rather than heavy yellow pine, for shipping containers. In another case, the same company saved $34,000 a year by changing from a casting to a stamping for a special part. On still another job in the same plant, machining a part from a casting rather than from bar stock cut annual costs in half.

Solving problems without knowing the facts is like shooting at targets in the dark. Getting the facts is hard work, but it's worth it. When the facts are known, solutions can be found.

Engineers in a different company had a particularly troublesome operation—drilling holes in plastic fittings. The plastic warmed up during drilling, gumming up the drill. In an effort to solve the problem, sharper drills were tried and the effects of different speeds and lubrication methods were investigated without improvement. The possibility of using another plastic material was considered, but only one material was suitable for the product. The possibility of changing to another plastic material, however, gave one engineer an idea. If he could not change materials, he could at least change the material properties temporarily. And that is how the problem was solved.

The plastic parts are stacked in a freezer next to the machine operator's bench. He takes out a few parts at a time and drills them while they are still hard and cold. The plastic shreds easily and the drill stays clean. To be sure, this was a "little" idea, but it solved a difficult problem.

Sources of Ideas

Engineering magazines can be one of the most fruitful sources of ideas. It is the function of such magazines to report on new ideas, new techniques, new products and new trends. Thus there is a constant stream of know-how from almost every industry. What tool engineers have done to solve a problem in the electronics industry or the textile industry may be the best answer to a problem in the automotive industry. This exchange of ideas works both ways, of course.

An engineer cannot expect to get all of his ideas from magazines and textbooks. People who are looking for ideas usually have to work to find them. A good way to hunt for ideas is to ask questions. According to Professor John Arnold, "The questioning spirit is the basic attitude, the first step toward being creative."

Some Guide Questions: The questions in the following list have been found helpful by many tool engineers. Although it is possible for each engineer to develop a set of questions to fit his own needs, these questions are a good starting point for almost any kind of operation.

1. *Is there something else that can do the job?* At General Electric Co. engineers studied the specifications for bolts and washers. Normally, a washer was ordered with every bolt. The study showed that it was possible, for certain applications, to order bolts without washers. The flash from untrimmed bolt heads is now used as a substitute washer. Savings from "finding something else that can do the job" are substantial.

2. *Suppose this were left out? Would it be better if it were smaller or shorter? Does it need all of these features?* At one company, a special chamfer

was specified for certain washers. The company had been ordering these special washers for years. Then a young engineer began to wonder why. Now the company orders standard stamped washers, costing half as much as the special washers. Again, this was a simple idea, but it was not put into effect until someone thought of ways for doing the job at lower cost. Someone had to ask the question "Does it need all these features?"

3. *What if this dimension were increased? What else can be added to make the product better?* In the machine tool industry, increasing the length of stroke of a planer or the wheel diameter of a grinder are typical examples of ways in which machines are improved, ultimately reducing manufacturing costs for the user.

4. *What is similar to this but costs less? What other materials would do this job?* Could a part be purchased from a specialty supplier at low cost? It is common knowledge, for instance, that 50 to 90 percent savings are possible by specifying bolts with rolled threads rather than machined threads. Nylon gears can replace steel or brass gears in small motors, controls and timers. They can give satisfactory performance at one-third to one-tenth the cost of metal gears.

Another example of a material substitution that has paid off is the use of tool steels for missile components. Previously, special high-strength alloys were specified to withstand the stress and temperatures at supersonic speeds. These alloys, of exotic materials, are extremely expensive. Finally someone asked "Why not try hot-work steels? They can withstand extreme stresses and temperature." It was determined that H-11 grade (5 percent chrome hot-work steel) is adequate for missile parts. While this material is not suitable for missile skins, it can be clad with stainless steel, which may result in aircraft and missile skin applications.

Questions Start Ideas

1. What else can do the job?
2. Does it need all these features?
3. What can be added?
4. What is similar but costs less?
5. Can operations be combined?
6. What other form can this be in?
7. What other method would improve efficiency? Shell molding? Die casting?
8. What change would make it easier to make, assemble or use?
9. What would happen if the sequence of operations was changed?
10. What do other industries do?

One of the best places to find ideas is on the job. Often a simple idea can pay big dividends in efficiency.

One company is making a "tapped" bushing without any drilling or tapping operations. First, flat sheet is blanked and thread ridges are coined in the blank. Then the bushing is completed by rolling the blank into cylindrical form. This was an effective answer to the question "What is similar to this but costs less?"

5. *Can two or more operations or materials be combined to get greater strength and efficiency?* An example of a successful answer to this question is the use of a combination drill-reamer to produce holes to close tolerances with fine finishes. When a product requires a hard wearing surface and a tough core, the two characteristics are combined by case hardening. When a product is massive or a stamping is complex, one practical technique is to design the product as a group of subassemblies that can be welded together to form a rigid unit.

6. *What other form could this be in?* Liquid, powder, paste or solid? Rod, cube, tube, triangle or sphere? Roller bearings are supplied as balls, cylinders and tapered cylinders. Adhesives are available in liquid, powder, paste, rod, film and other forms. Selecting a different form may solve an urgent manufacturing problem.

7. *What other method would improve efficiency?* Rough turning and milling operations can often be completely eliminated by producing a part by shell molding instead of by conventional sand casting. If a shop has only a few gears to make, they are usually cut on a machine. When larger quantities are required, die casting may be an effective way to cut costs. The die casting process takes minutes, rather than hours. Ultrasonic machining may be the best way to cut hard materials.

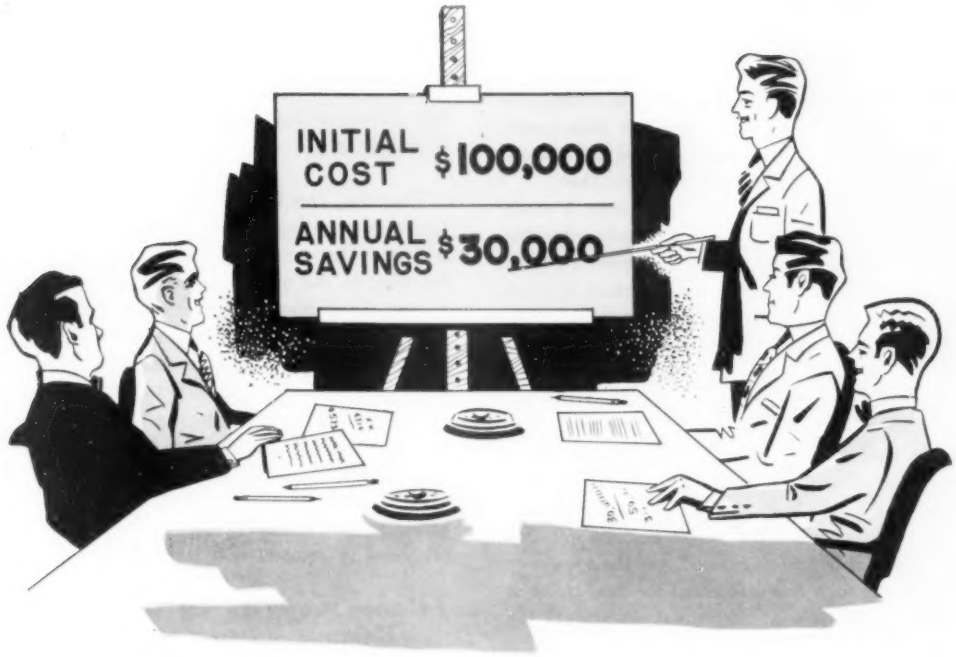
8. *What change would make it easier to make, assemble or use? What change would improve safety?* Answers to these questions often involve common sense, rather than engineering ingenuity.

9. *What would happen if the sequence of operations were changed?* Should the job be done at another location? One company had trouble deburring the ends of spur gear teeth. When deburring at high speed with a grinder, fine burrs remained. The problem was solved by deburring immediately after the hobbing operation. Grinding burrs disappeared in subsequent shaving and finish grinding operations.

10. *What do other industries do when faced with a problem like this?* What is in the patent literature or trade journals? Are similar parts available on the market? If so, should they be purchased rather than made in the plant? Are present methods the result of custom, tradition or opinion? Use of adhesives in industry is a good example of the interchange of ideas. At Lionel, it was found that epoxy adhesives could be used to bond Alnico magnets to the undercarriages of model trains. Adhesive bonding replaced a silver-soldering operation.

A Westinghouse engineer learned of this development and redesigned a wattmeter so that adhesives could be used to bond magnets to silicon steel. At SKF industries, the same technique was used to bond periphery guides for surface grinders and to permanently bond tungsten carbide to steel.

Employers will listen to men with ideas. The engineers who get ahead are the engineers who have learned how to present their ideas successfully.



When selling an idea to management, successful engineers use charts, models, photographs and other visual aids. They apply creativity to promoting creative ideas—as all successful salesmen do.

In the latter instance, replacing a high-temperature brazing operation with adhesive bonding materially reduced scrap losses caused by thermal cracking.

In all of the cases that have been discussed, someone analyzed the value of what his company was doing and thought of ways to do it better. Officials of the U. S. Navy have estimated that for every dollar invested in value analysis—asking questions about existing operations and finding improved ways of doing things—there is a 20-dollar return.

When Answers Don't Come . . .

New ideas often come during periods of relaxation. Sometimes the best thing to do when studying a perplexing problem is to forget about it for a while. Charles Duryea worked for many months on the design of the first automobile engine and reached a point where he could not find answers to the problem of mixing air and fuel in the proper proportions. The answer came one evening while he was watching his wife using a perfume atomizer. The atomizer gave Duryea the idea for the first automobile carburizer.

Another means for generating ideas is known as the "buddy system." There are two approaches that can be used. In one, the "tear-down" method, one engineer takes the attitude that everything about the present method is wrong and suggests another way of performing the operation. A second engineer, the "buddy," is also a tear-downer. He suggests an alternative method. The first engineer then supplies still another method. This approach is carried out until both engineers agree on one best method for doing the job.

A widely discussed result of the tear-down approach involves a plant superintendent and two general foremen at Hotpoint Co. Their request for a $200,000 conveyor system had been turned down by management. By using the tear-down method, they finally devised an equally efficient system that cost only $4000.

Another buddy technique is the "and also" method, where each engineer agrees with the other's suggestion, but adds to it. For instance, one engineer might suggest a method for reducing clamping time for a machining operation. A second engineer suggests an improvement on the method suggested by the first engineer. Eventually, a sound solution is worked out, perhaps a different machine, special clamps, magnetic chucking or, if the workpiece is easily deformed, vacuum chucking.

How To Sell Ideas

It takes initiative to make creative ideas pay off. Before ideas can be put to work they must be sold to company management. There are five practical steps that can help engineers get their ideas off the memo pad and into production.

1. Sell the boss on the idea first.
2. Plan how to meet objections.

3. Create ideas for selling ideas.
4. Emphasize the benefits.
5. Make it easy to say yes.

Selling the Boss: The first step in selling an idea is to present it to the immediate supervisor. The "case" for the idea should be stated moderately and accurately. Overselling should be avoided.

Since supervisors are usually busy men, a short report has a better chance of being thoroughly read and digested than a long one. If, however, a supervisor has an analytical mind, thoroughness is more important than brevity. Supervisors of this type appreciate a list of pros and cons as an aid to evaluating the idea.

Perhaps the most difficult part of selling an idea is to get the supervisor interested. There are many successful techniques, but one that works often is to ask for advice. "Say Charlie, would you help me with this . . ." Most supervisors are receptive to such an approach. If a supervisor doesn't like an idea when it is first suggested, yet the suggester still thinks the idea is worthwhile, the best thing is to present it again with additional arguments for its adoption.

It should be pointed out that one of the most important responsibilities any supervisor has is to find out the good features of an idea. It is all too easy to find faults rather than positive values. Supervisors, however, are in a position to combine the good features of an idea with additional ideas, leading to a double-barreled attack on the problem at hand.

How to Meet Objections: No matter how good an idea is, there are always some people who find fault with it. The best way to meet objections is to plan for them in advance. Acceptable answers should be prepared to show that all aspects of the idea have been thoughly thought out.

Ideas Sell Ideas: Industrial leaders often comment that those who have ideas often don't think their ideas through clearly before presenting them to others. And, more important, few people who have ideas have a clear-cut plan for carrying their ideas out.

Engineers who are successful in selling ideas think up many ways to present those ideas effectively. They use sketches, diagrams, photographs and whatever else seems appropriate to help management visualize ideas in action. If a project is important enough, they make working models. Demonstrating an idea is better than just talking about it.

In presenting the idea, the discussion should be organized around key points. Details can be left for the discussion phase.

Almost any job can be done in several different ways, so successful engineers often suggest (or have in reserve) alternatives along with the idea they most want to sell. It may be effective to make two or three free-hand sketches of different methods for doing the same thing. Management can quickly decide on one of the alternatives if they are presented in a clear way.

Showing the Idea Will Pay: The most important step in selling ideas is to show what the benefits will be. The over-all approach depends on who is listening to the idea. Successful salesmen are able to put themselves in the customer's position. For instance, supervisors in the lower levels of management are most strongly interested in plant problems and presentations directed to these supervisors should concentrate on engineering feasibility. At higher levels of management, people are more concerned with financial matters than they are with engineering. Higher management, when being asked to spend money, has to be shown that the proposed investment will make or save money.

Getting People To Say Yes: Once all objections have been answered and all the advantages of putting an idea into effect have been presented, one step remains—the plea for action. At this point, the key to success is to make it easy to say yes.

One of the best approaches is to offer to test the idea. Any idea that can be subjected to a "road test" should certainly get one. When ideas are debated instead of tested, a poor idea, supported by a good debater, makes a better showing than a good idea, supported by a poor debater. When, on the other hand, ideas are tested, good ideas stand out.

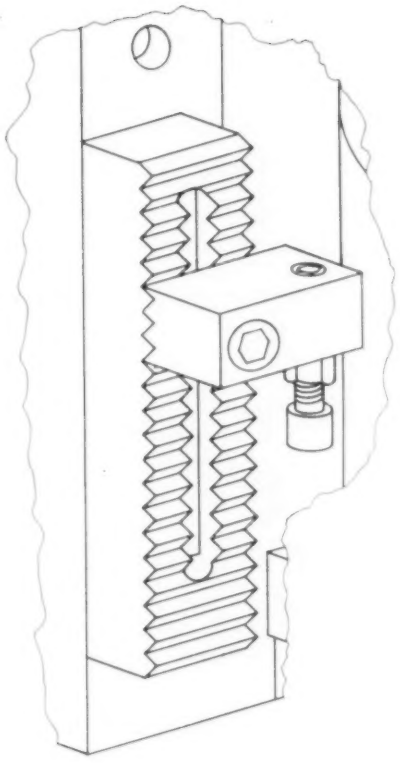
Another approach, useful when selling proposals that entail major changes or expenditures, is to break the proposal up into three or four parts, each of which can be installed separately. This progressive step-by-step method is often acceptable to management when the over-all "big idea" involves sweeping changes.

As a final step, successful salesmen of ideas sum up the points they have made. They talk about the anticipated results and advantages briefly, then re-emphsize the need and, if appropriate, end their presentation with an appeal for action.

To Summarize: New ideas are urgently needed to increase production, reduce costs and improve products. All new ideas are the work of individuals. Anyone can generate ideas if he looks for problems that call for a solution, ferrets out the facts and devotes time and thought to creative thinking. However, company files are full of good ideas that were never adopted because they were not properly sold to management. The real test of a creative engineer is his ability to see that his ideas are put into effect. The real need of industry is for engineers who can do just that—and turn ideas into profits.

Gadgets

Ingenious Devices And Ideas To Help The Tool Engineer In His Daily Work

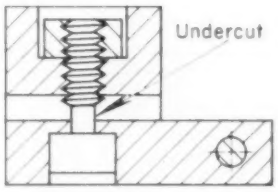


Knockout Arm

In many plants, it is common practice to weld knockout arms to dies. Adjustments are impossible and if a drawn part gets jammed, the knockout arm may be broken off or the die damaged.

The knockout arm illustrated can be adjusted or removed by loosening one screw with an Allen wrench. Since the screw is undercut as shown in the cross section view, it breaks when subjected to unusual force. Neither the die nor the arm itself will be damaged.

Harold Petterson
Santa Clara Chapter

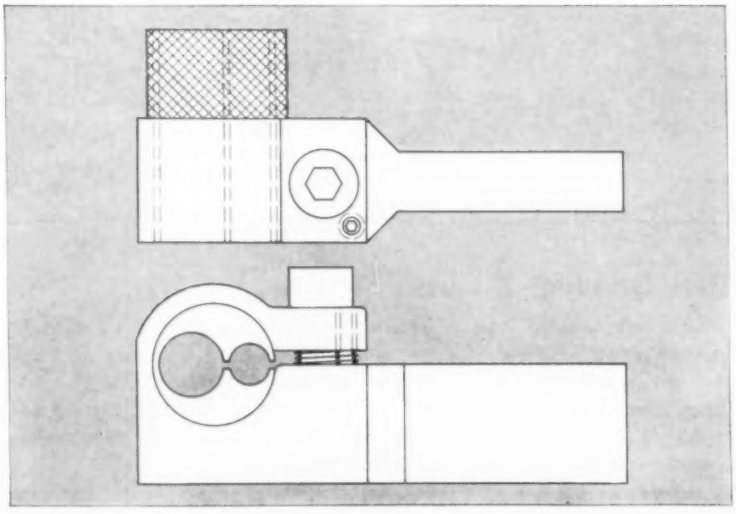


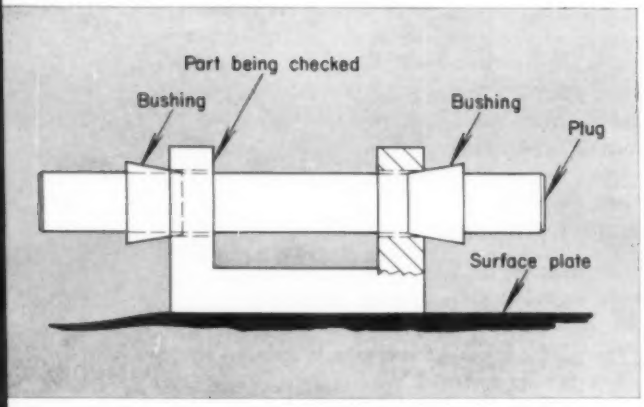
CROSS SECTION

Boring Bar Holder

Boring bar operations are expedited by using the universal holder illustrated. This holder has a ½ and ⅜-inch boring bar capacity. Split brass sleeves can be inserted into either bore to accommodate bars of intermediate or smaller sizes. The knurled member can be revolved to find the center line of the spindle.

Paul Cox
Des Moines, Iowa



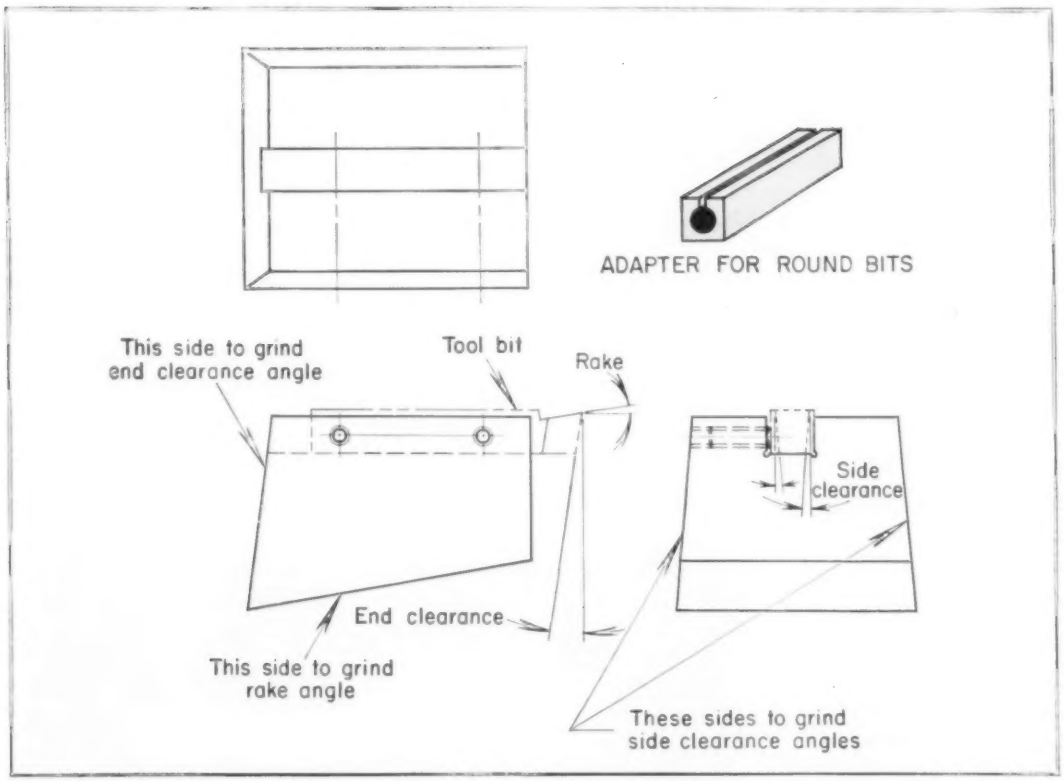


Hole Alignment Gage

Alignment of holes in opposite walls of a workpiece can be quickly checked with the gage illustrated. The gage consists of a plug, of any length and diameter to suit the application, and two tapered bushings. These bushings are a slip fit on the plug.

To check hole alignment, the plug is inserted through the holes and both bushings are positioned against the lips of the holes. If both ends of the plug are the same distance above a surface plate, as determined by an indicator, the holes are in proper alignment.

Thomas J. Bizzoco
Greater New York Chapter



Tool Grinding Holder

Tools are usually ground with the aid of a special vise for setting them at the required angles. Making angular adjustments is time consuming. When large numbers of identical tools are to be ground, a toolholding block like the one illustrated is a wise investment. The tool is held in the block by setscrews.

Each side of the block is at the correct angle for grinding a specific tool angle when the block is placed on the table of a surface grinder. With an adapter, the holder can also be utilized for sharpening round tools.

Robert M. Dickson
Springfield, Mass. Chapter

Gadgets

Engine Lathe Performs Twisting Operation

Some production problems may be solved by unusual applications of standard tools and equipment. Fabricating small lots of special ladder rungs offers an excellent illustration. The rungs are of Type 304 stainless steel, 18¾ inches long. They must be twisted one full turn every 8½ inches.

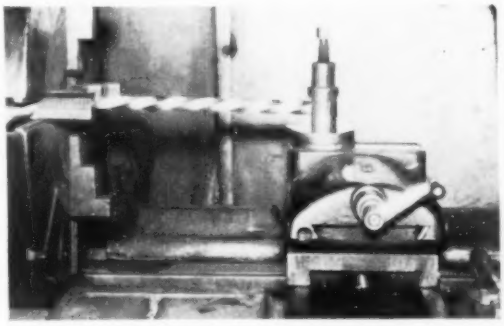
A heavy-duty engine lathe is used for the job. The 7½-hp machine is of the back-gear type. Using two of the four jaws of an independent chuck, the bar is gripped for a distance of one inch at one end. The lathe cross-slide is positioned so that the tool post is centered with the chuck.

About one inch of the bar end is clamped with the tool post screw, which has a ⅞-inch diameter. After clamping, the lathe carriage is locked in position. Twisting is accomplished at approximately 4 rpm. Two full turns, plus an allowance of ¼ turn for springback of the cold bar, provides the required twist in the ladder rung.

Twisting by this method requires no allowance for reduction in part length. The chuck and locked carriage hold the bar ends securely, so the twisting results in a slight stretching of the piece.

Naturally, use of equipment in a manner not within the scope of its normal operation calls for care and discretion. The equipment must not be overloaded or strained and proper safety precautions must be taken.

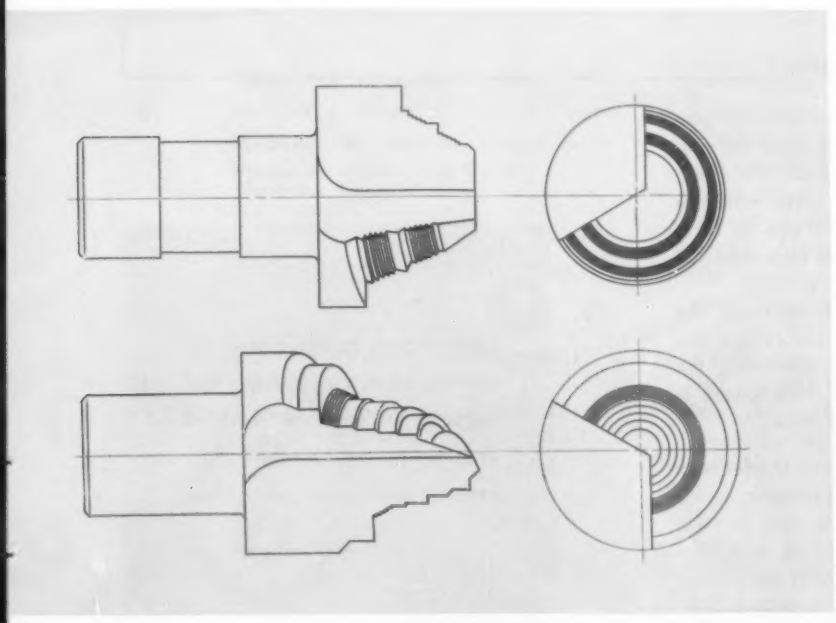
Clement F. Brown
Willow Grove, Pa.



Circular Form Boring Tool

Tools of the type illustrated have replaced step drills, flat bits and flat reamers on single and multispindle screw machines. They have also been successfully used for some secondary multidiameter boring operations on lathes and tool-rotating boring machines.

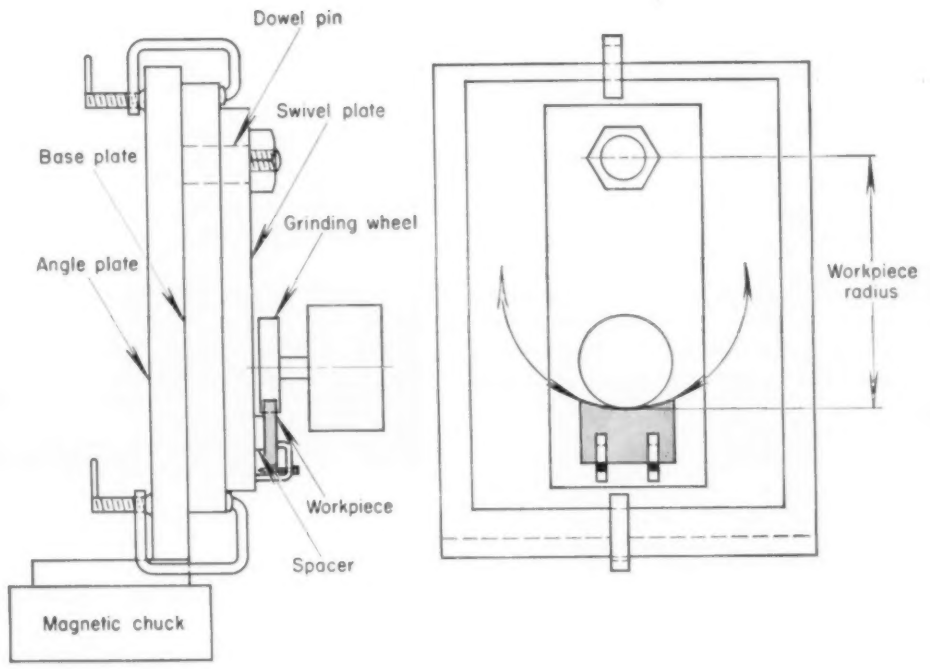
In one instance, three step drills were replaced with one circular form tool. Cycle time was reduced from 45 seconds to 35 seconds. An added advantage was the fact that the circular form tools could be resharpened by the machine operator. Previously, it was necessary to keep three sets of step drills at the machine while one or two sets were being sharpened in the toolroom. The drills also caused chip problems.



Circular form tools can be sharpened by any operator. The tool center is above the workpiece center to provide tool clearance. Workpiece diameter is controlled by cross adjustment of the tool.

Al Bethke
Ann Arbor, Mich.

Gadgets



Radius Grinding Fixture

When no suitable grinder was available for generating a radius on a small workpiece, the improvised fixture illustrated was devised. The workpiece is clamped to a swiveling plate which is mounted on a base plate with a dowel pin. In turn, the base plate is clamped to an angle plate mounted on the magnetic chuck of a surface grinder.

Wtih one hand, the operator feeds down the grinding wheel. Simultaneously, he swings the swivel plate back and forth, thus generating the required radius on the workpiece. This fixture is low in cost, and produces accurate work.

Raymond O. Andrews
Detroit Chapter

Contributions for these pages describing short cuts for the tool engineer are welcome. Finished drawings are not necessary. Payment is made upon publication.

PLANNED TOOLING

expedites bench operations

Fig. 1. Operator fatigue was reduced by having this fixture open and close split rings by air.

By **Millard T. Douglas**, Technical Writer
Helmut J. Haag, Production Planner
Kenneth W. Horton, Project Leader
Operations Engineering Branch
Watervliet Arsenal
Watervliet, N. Y.

Searching for new ways to improve manufacturing methods, engineers at Watervliet Arsenal turned attention to bench operations. The investigation proved fruitful, illustrating that the efficiency of this phase of manufacturing can be materially increased to result in substantial savings.

FREQUENTLY, IT IS NECESSARY to improve surface finish or correct the shape of a machined surface with hand tools. Often these time-consuming operations at the bench are taken as matter of fact and overlooked when production methods are being reviewed. A survey at Watervliet Arsenal revealed that benching methods could be substantially improved to speed assembly time and reduce costs.

Soldering: For successful soldering of a split ring used on a 106 mm gun, it is necessary to bench form the mating surfaces in order to obtain the proper contact. Frequent opening or spreading of the separated ends of the ring, is required to allow stock removal. Reinspection of the mating surfaces can be done only when the rings are closed.

Using the old method of performing this operation, the rings were clamped in a holding fixture and forced to the open position by means of the

direct pressure of the end of a screw. Opening and closing the part was performed approximately 58 times on each ring and required 10.6 minutes per piece. By accomplishing opening and closing by compressed air, *Fig.* 1, time for mating the rings was reduced by 10 minutes per piece and a significant reduction in operator fatigue was achieved.

Rotating Fixture: Following completion of the various turning, threading and milling operations, the 106 mm vent ring bushing and breech block, are routed to the benching section for removal of burrs and correction of other minor machining imperfections. Previous practice was to position these pieces in wood V-blocks where they were corrected with a variety of small hand tools. Rapid wear of the wooden V-blocks made repositioning of the components laborious and decreased efficiency.

A holding fixture, *Fig.* 2, with two free turning rollers mounted in bronze bearings solved the problem. The fixture supports the workpiece in the proper position and allows for easy rotation during benching. This has resulted in a significant increase in efficiency reflected in a time saving of six minutes per component. A similar fixture was developed for checking after another bench operation. Replacing cast-iron V-blocks, the fixture has chrome-plated rollers mounted in ball bearings.

Fig. 2. Holding fixture with rollers allows easy positioning of round workpiece for hand operations.

Deburring: Drilling of evacuator holes around the periphery of rifled tubes necessitates deburring of these holes within the bore. Due to the elliptical configuration of the holes on the inside of the tube, this operation does not lend itself to the successful application of standard internal expanding deburring tools. While burrs of this type cannot be tolerated in any rifled tube, their elimination is especially critical on tubes that are to be chrome plated since retention of any sharp edges has a deleterious effect on plating.

Evacuator holes are so located as to penetrate the rifled inside surface of tubes at the groove locations only. Consequently, burr removal on these holes from the inside of the tube was previously accomplished through use of small hand tools shaped to fit the rifling grooves. These tools, consisting of small files, abrasive stones and abrasive cloth were fastened to long wooden rods to permit their extension to the depth necessary for deburring operations. Due to slippage, poor leverage and weak construction of the tools the resultant surface finish was

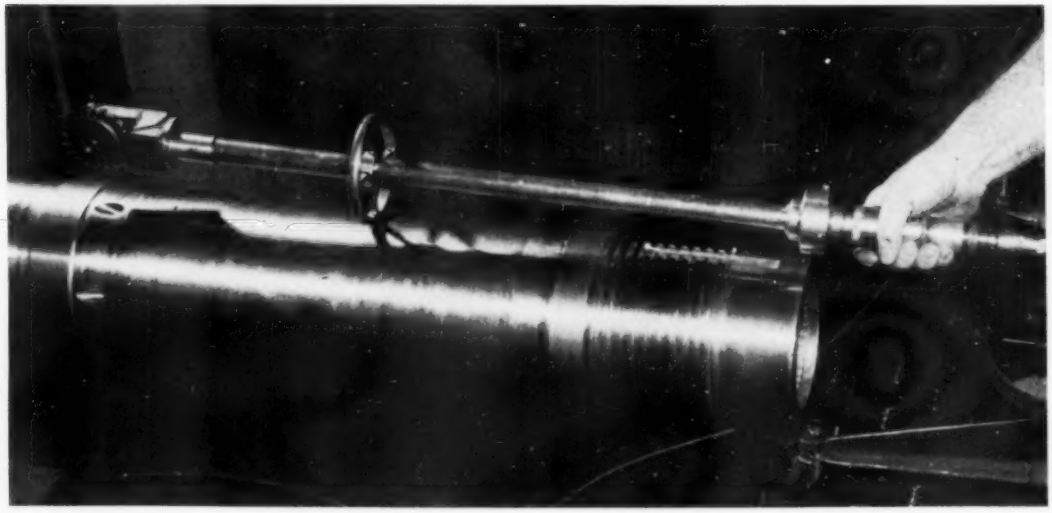


Fig. 3. Wire brush for deburring holes inside rifled gun bore reduced operation time from 18 to three minutes.

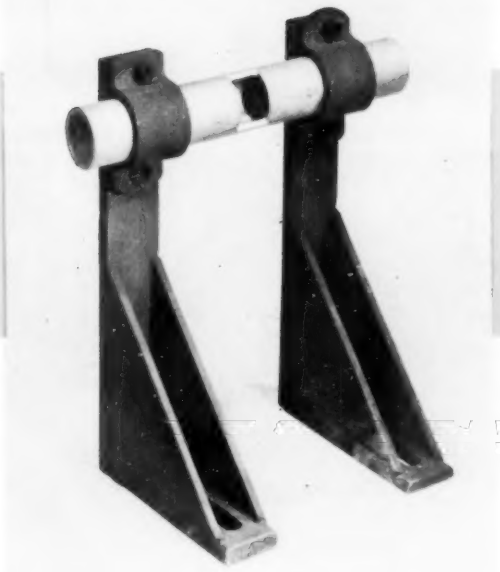


Fig. 4. Fixture for wire brushing cylindrical parts. Tube is inclined and parts travel through by gravity. As parts pass opening, they are deburred by a high-speed wire brush. Time of brush contact is determined by tube angle.

generally uncertain, and operational time was high.

Investigation of this manufacturing problem resulted in design of the device shown in *Fig.* 3. It consists of a 3-inch wire wheel geared to the end of a rigid tube and powered by a motor-driven flexible shaft rotating at 1700 rpm. Operating time was decreased from 18 to three minutes and rework following inspection was virtually eliminated. A sliding guide ring centers the unit within the bore and permits a pivoting action, allowing for proper contact of the wheel against the burrs. By changing the size of the guide ring this basic unit can be adapted to tubes of all sizes.

Wire Brushing: Adoption of the fixture shown in *Fig.* 4 eliminated a considerable safety hazard caused by the old method of wire brushing small parts. The old method required that the operator hold the parts to be brushed in contact with a rotating wire brush. This frequently caused the parts to be thrown from the operator's hands and required close proximity of hands to the brushing tool.

In use, this fixture is mounted so that the horizontal center line of the spindle, mounting the high-speed wire brush, bisects the opening in the fixture tube. The tube is mounted at a slight angle from the horizontal. Cylindrical parts are inserted in the higher end of the tube. As the parts pass through the tube and past the opening they are rapidly cleaned and buffed without danger to the operator. Reduction in manufacturing time achieved through use of this fixture has been considerable. It is now possible to wire brush 20 parts in the time previously required for one.

The size of the tubes used in these fixtures is changed to accommodate various size parts, but

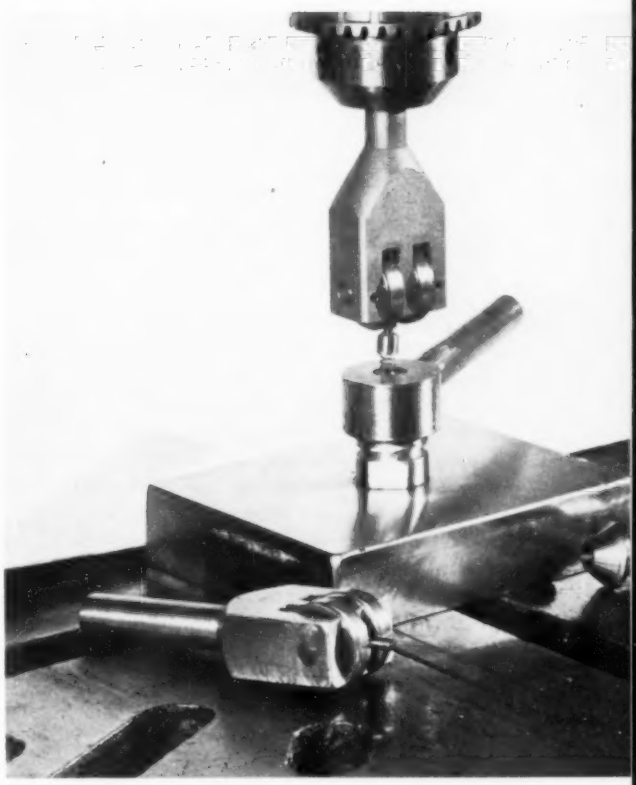


Fig. 5. This tool holds spring assembly while forming flange which fastens unit together. Processing time is reduced from 22 minutes to 30 seconds.

must be from 1/32 to 1/16 inch large than the OD of the parts. This fixture is also suited for use with buffing wheels. The speed at which parts progress through the tube is controlled by its inclination. Too great a pitch will result in parts leaving the tube at excessive speed. The amount of tilt also determines the length of time that the workpiece is presented to the wire brush or buffing wheel and is consequently a means of controlling the degree of finish produced.

Spring Assembly: Two of the component parts of the T-95 firing lock are plunger type capsules. These subassemblies consist of a case, holding either

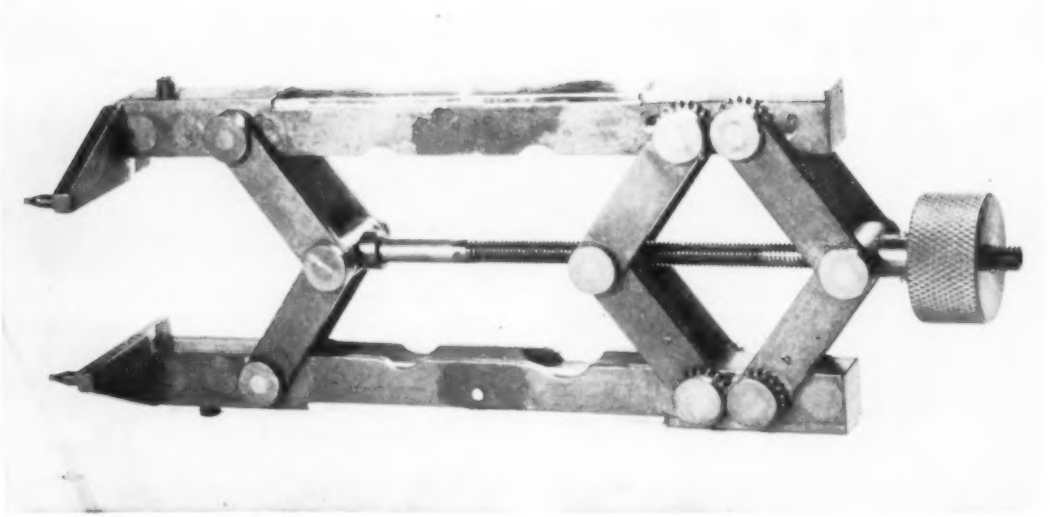


Fig. 6. Special tool for inserting retaining rings. Tips are interchangeable for different types of rings. Degree of ring expansion or contraction is repeatable and sustained hand pressure is not necessary.

two plungers and a spring or a cup and a spring when assembled. Assembly requires insertion of plungers or a cup and spring.

In order to seal the open end of the case, the rim is spun over in the form of a small radius and retaining flange. The old method of accomplishing this involved mounting the case in a collet in the headstock of a bench lathe and holding the plungers in position by means of the tailstock spindle of the machine. At this point, the spindle of the machine was put in motion and the rim of the case rolled over by means of a formed tool bit forced against the case. This operation required 22 minutes floor-to-floor time per component.

Tooling for this operation now consists of a roller head and a holding fixture, *Fig.* 5. The roller head has either a pin or bushing type centering device, depending upon the capsule being assembled, and two hardened rollers with proper corner radii for forming of the retaining flange.

The roller head is clamped in a drill press chuck in alignment with the center line of a collet in the holding fixture. The capsule case is inserted in the collet and the clamping collar tightened. Plungers and spring are then inserted. The second plunger is positioned over the spring and the roller head is brought down over the assembly. At this point, the machine spindle is put in motion (100 to 150 rpm) and fed down to form the retaining flange on the capsule. Floor-to-floor time has been reduced to 30 seconds.

Retaining Rings: Many retaining rings are used in gun manufacture for positioning and retaining components on shafts and in housing bores. Various accessories and pliers are commercially available to expand and contract the rings to accomplish insertion. Their use requires considerable hand pressure and a definite expansion is difficult to duplicate. In cases where rings must be positioned at considerable depth in a bored hole, a plier type expanding tool is not practical.

Illustrated in *Fig.* 6 is a tool designed for insertion of retaining rings. It is opened or closed by means of a screw adjustment and has made possible assembly operations which were previously most difficult. By altering the design of the tips any type of ring can be accommodated.

These examples of benching methods illustrate how slight modifications in present tools and construction of inexpensive new tools can materially reduce safety hazards, operator fatigue and assembly time. They prove that cost savings can be realized in even the simplest shop operations.

"Expevience?—Why yes, I had a strange one only yesterday."

principles and applications of HONING FIXTURES

By John H. Greening
Chief Engineer
Micromatic Hone Corp.
Detroit, Mich.

To obtain parts without distortion by honing requires fixtures properly designed to resist rotational and reciprocational forces. The author shows some successful designs of tools to illustrate the proper use of the process.

EXACTING TOLERANCES demanded by manufacturers have fostered more extensive use of the honing process. With this increased demand, a better understanding of the principles of honing fixture design is needed by the manufacturers using the process.

By the nature of the process, which corrects the geometry of a part machined by other processes, special attention must be given the fixture design to assure proper workpiece location. Fixtures must hold the part against the forces of rotation and reciprocation. In addition, the abrasives on the honing tool must be free to align with the neutral axis of the workpiece bore.

Honing fixtures are similar to other types of fixturing where the part is held rigid and a universal or floating action is part of the tool. This condition requires two universal joints to be incorporated in the tool to correct any variation between the machine and the workpiece, *Fig.* 1. Variations can exist in the parallelism of the workpiece faces, angular displacement of the hole in the workpiece relative to the location face or due to misalignment of the machine center line to the workpiece center line.

Precision obtained with the honing process makes necessary the elimination of even the smallest

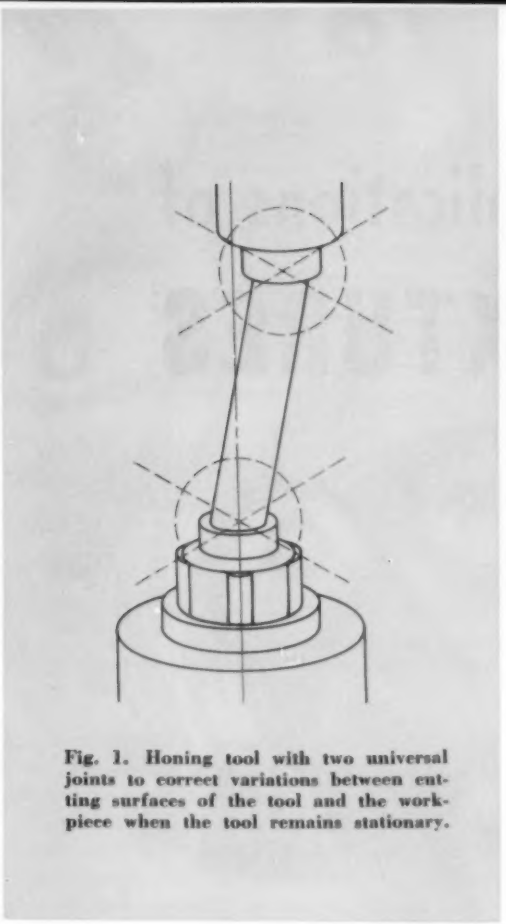


Fig. 1. Honing tool with two universal joints to correct variations between cutting surfaces of the tool and the workpiece when the tool remains stationary.

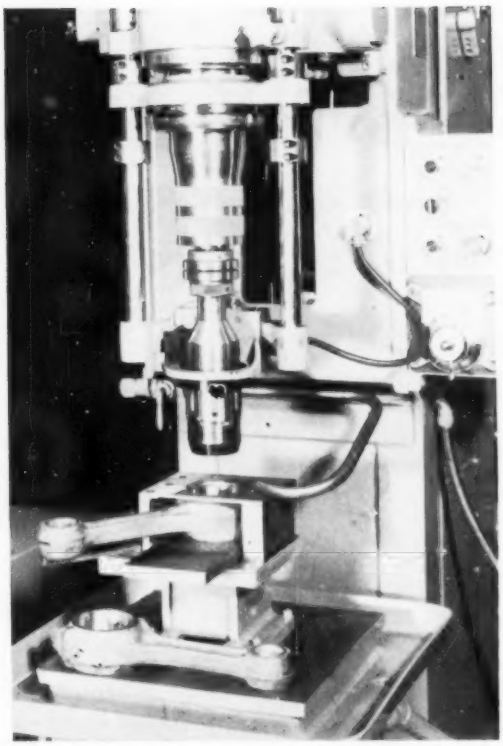


Fig. 3. Simple parallel-plate fixture for a connecting rod with a block for controlling torque of the operation. The tool is rigid and takes possession of the part.

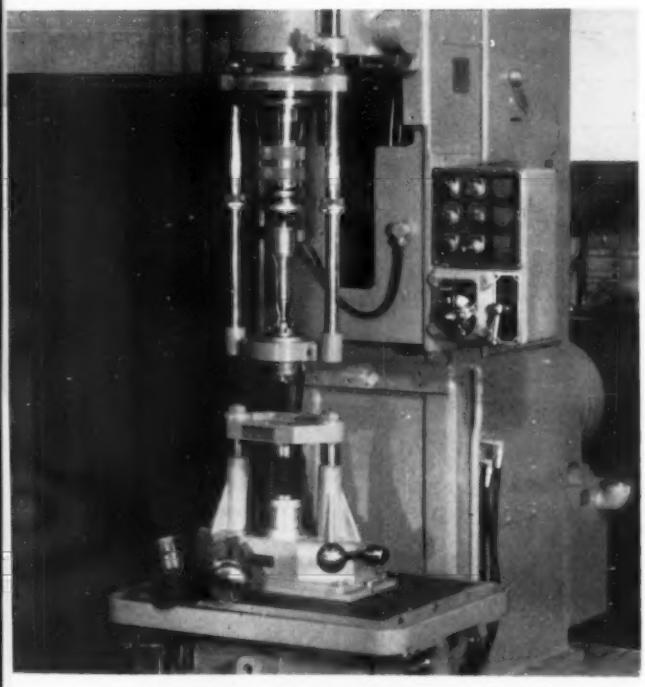


Fig. 2. Parallel-plate fixture uses a pump jig for clamping workpiece. Locating and clamping surface must be parallel to prevent part distortion.

amount of strain that may be put into the workpiece by fixturing. Part distortion that would not be noticeable in less accurate machining operations becomes a major consideration in honing. This is especially true in the machining of thin walled cylindrical parts.

If a regular end clamping pump jig type fixture is used to hold the workpiece then the faces of the part must be parallel or the part will distort during clamping. *Fig.* 2 is an example of this type of fixture.

If needed, special adaptations can be made to the pump jig to compensate for any out of parallel condition that might exist. One method of doing this is putting spherical seats at the top and bottom of the fixture. In many cases, this solution is satisfactory, but spherical seats have a force component that reacts parallel to the machine base. When the seats move to take up the out of parallelism, part distortion can result from the reactive forces.

A better method to compensate for the lack of parallelism has the bottom part of the fixture rigid and a full floating gimbal at the top. This construction permits the fixture to take up for out-of-parallelism without any sideward motion.

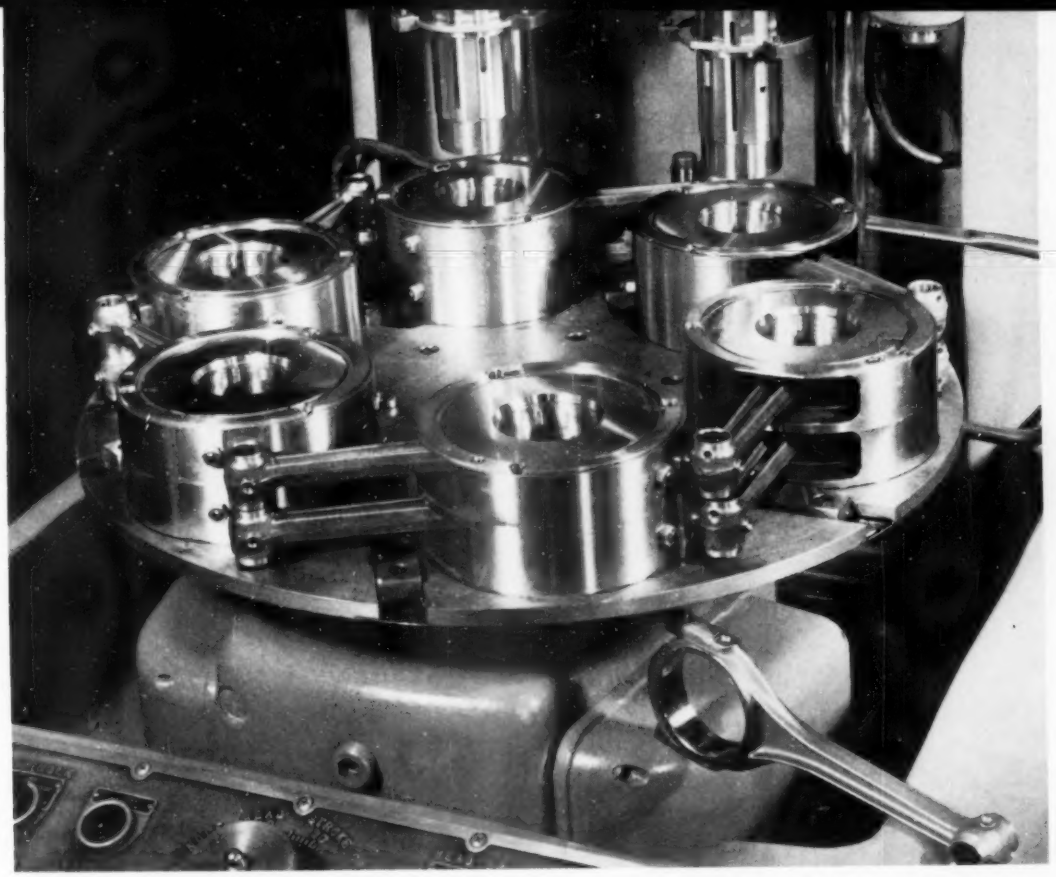


Fig. 4. Fixtures with full gimbals mounted on a rotary index table. Variations of squareness between bore and faces of the workpiece cause the fixture to cock with each reciprocation to prevent distortion.

A part that is held in an end clamping fixture must be clamped so that the forces on the opposite ends of the clamp are directly opposed. If the force at the top of the clamp is offset from the force at the bottom, a couple is formed to cause part distortion.

With rigid fixturing another factor should be considered. Any point where torque is taken must be located to prevent part distortion. Experience is required to determine the proper point for taking torque on many honing operations.

Another variation of honing fixturing places all of the floating action taking place in the fixture while the tool is held rigid. The simplest illustration of this type is the parallel plate fixture, which has two parallel plates and a method for controlling the torque on the workpiece. As shown in *Fig.* 3, the tool is rigid and will take possession of the part during operation. Parallel plates take the upward and downward thrust and the torque point controls the rotational force.

In this type of fixturing, the torque point is more critical than in rigid fixturing. If the maximum efficiency of operation is to be obtained, the plates must be parallel and the faces of the part should be paral-

Fig. 5. Combination of workpiece and tool float to correct variations during honing. The part is located in a gimbal and the tool has one universal joint to help take up the variations.

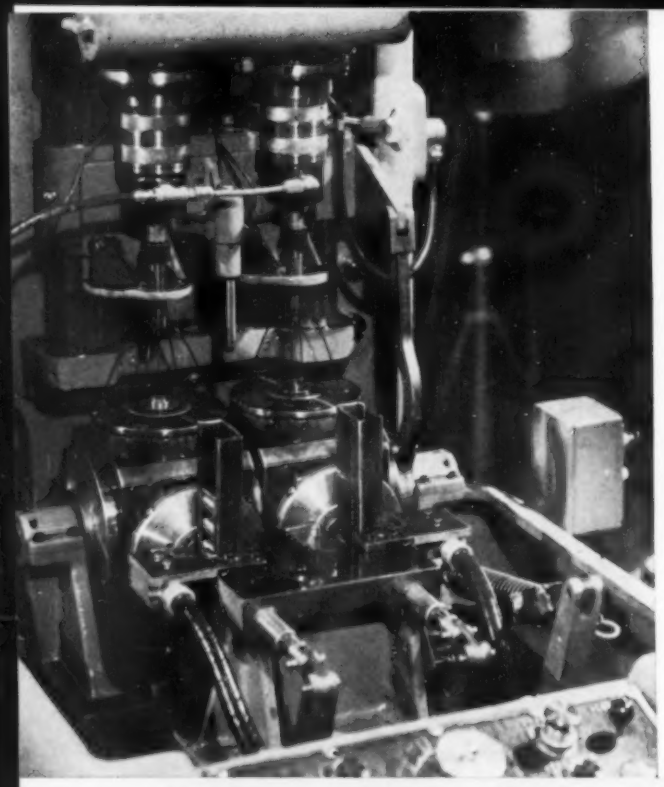


Fig. 6. Coolant supplied to the cutting zone through the honing tool is used when extreme conditions dictate such as in part with a long bore small in diameter. The fixture is a four-position trunnion type with magazine load and gravity unload.

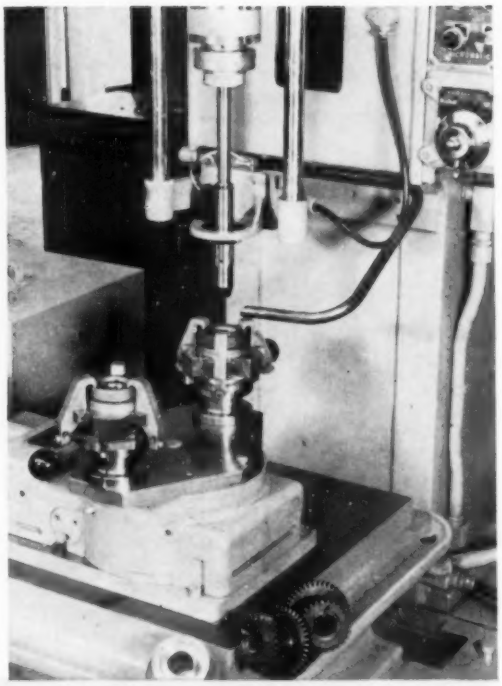


Fig. 8. Rotary index table used for the two positions, load-unload and honing. Part is loaded and clamped manually, then indexed under the spindle for honing, while the finished part is rotated to the unload position.

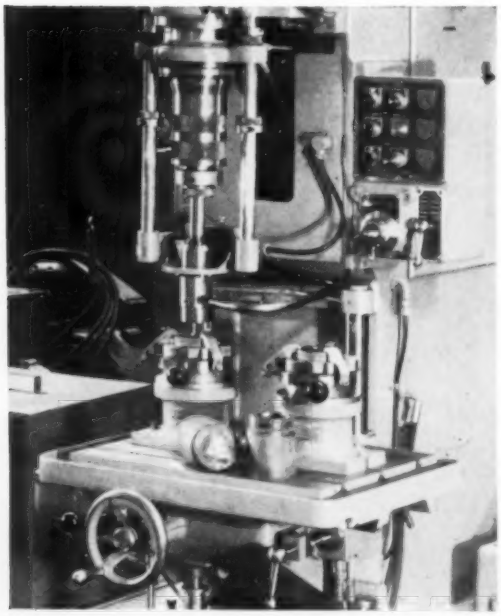


Fig. 7. Load while honing arrangement has one fixture being loaded while the other is under the machine spindle. On completion of the operation, the fixture shuttles to an unload position and the other fixture is positioned for honing.

lel within predetermined limits. When the part faces are not parallel, the part has a tendency to rock when it hits the off parallel face. This rocking action causes longitudinal twisting which forces first, one side and then the other side of the part into the abrasives. Not only a loss of accuracy may result, but also abrasive stone wear will be excessive.

Parallel plate fixturing is used most extensively on parts that have a large diameter compared to their height. If the faces of the part are not square, the parallel plate fixture may be put into a gimbal, as shown in *Fig.* 4. In this way, the fixture cocks with each reciprocation and eliminates the twisting action on the part.

A third honing fixture arrangement is designed to use a combination of workpiece and tool float, illustrated by *Fig.* 5. In this type of fixturing the workpiece is put into a gimbal so that alignment can be obtained angularly in all planes in relation to the tool. A single ball universal joint is used on the tool. Spindle to workpiece misalignment is removed by having the tool operate on an angle and the workpiece tilted so that the neutral axis of the workpieces

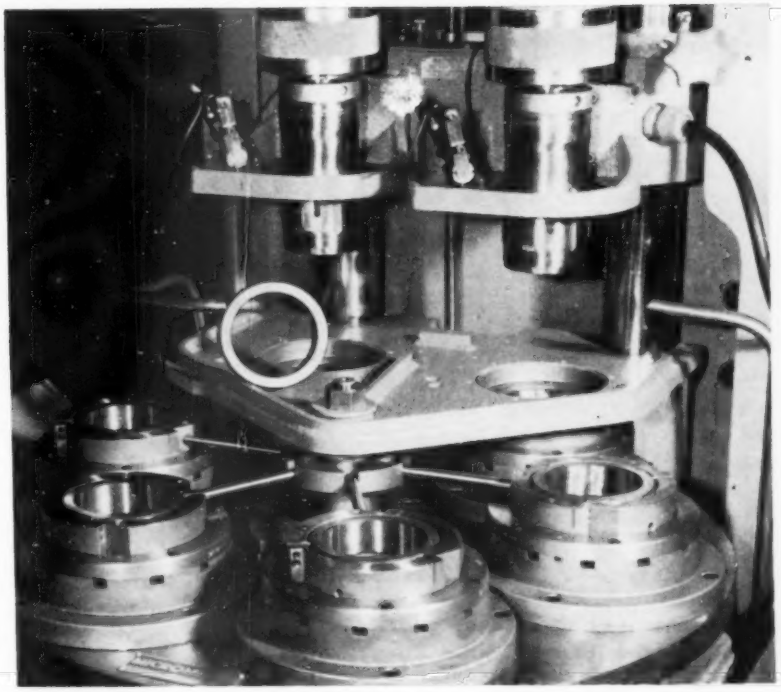


Fig. 9. Six-position rotary index honing fixture with automatic clamping. Two operations, rough and finish, are performed in successive positions during the cycle.

is aligned with the neutral axis of the tool. This type of honing is used extensively where extreme precision is required.

In honing fixture designs, special care must be taken to assure that a copious supply of clean coolant is available at the inner face between the abrasive honing stone and the workpiece. The methods by which this can be done are limited only by the ingenuity of the fixture designer. In some fixtures special coolant passageways and orifices are placed in the tool guide bushing. These passages may be designed so that an even supply of coolant covers the whole face being honed. *Fig.* 6 shows an extreme case where the coolant has been piped through a honing tool to direct the coolant at the abrasive stone cutting surfaces.

In most honing applications, the honing time is very short and therefore the load and unload time of the workpiece must be kept to a minimum to insure maximum productivity from the machine. Two alternatives to obtain a proper cycle balance are available. Either the load and unload time must be kept extremely simple and fast, or multiple fixtures should be used. One fixture can be loaded while the other one is under the work spindle.

This load-while-honing system can be accomplished in a variety of methods. One design makes use of lateral index table similar to the arrangement illustrated in *Fig.* 7. The machine is initially loaded on the left-hand side and then on the right-hand side as the table shifts from one side to the other.

Another method uses a rotary index table where the part may be loaded into the fixture at the front of the machine, *Fig.* 8. Indexes may be 180 degrees, where a simple single spindle, one operation application is sufficient. On the other hand, a six-station rotary index table can be used on a two-spindle rough and finishing operation as shown in *Fig.* 9. A part is loaded into a fixture while one is being rough honed. On the second spindle, another part is being finish honed. All the operations are performed on the parts simultaneously.

When automation is used, all the factors discussed must be considered plus the positive handling of the part into and out of the fixture. This positioning must be accomplished with minimum loss of time and a maximum of dependability. Parallel plate type fixtures are readily adaptable to magazine loading with a minimum of expense, but the rigid or universal type of fixturing can also be automated. The main fallacy encountered in the automation of honing fixtures is that basic honing principles may be compromised for the ease of automating the operation. An experienced designer is required to determine the proper fixture requirements to obtain the full benefits of the precision and size control possible with honing on a safe dependable automated fixture.

Understanding the principles behind successful fixturing for honing will help the users to properly apply the process. In this way, the full potentials of honing to produce precision finished parts will be realized, while keeping costs at a minimum.

Fabricating Superalloys

By H. E. Haley
Haynes Stellite Co.
Kokomo, Ind.

High speeds of aircraft and missiles call for materials that can withstand severe aerodynamic heating. High-strength alloys selected for this service require special fabrication techniques to insure retention of necessary physical properties.

HIGH-STRENGTH ALLOYS, or superalloys, are generally regarded as those materials which maintain superior physical properties at high temperatures. Service range for a superalloy is from 1200 F to within about 100 degrees of the melting point. The qualities that make these alloys useful also hinder fabrication so that special techniques are required. TABLE 1 lists superalloys in present use.

Although superalloys are described in terms of their heat resistance, all have some degree of corrosion resistance because of their high alloy content. In fact, some alloys were originally developed for resisting various corrosive media but have proved useful in high-temperature applications. The converse is also true. The Ni-Mo-Cr and Ni-Mo-Cr-Fe alloys are good examples of materials designed for corrosion resistance but used extensively in elevated-temperature applications. The requirements of superalloys for corrosion-resistant service are also increasing because of increases in operating temperatures in the chemical process industries. Special care must be taken in fabrication in order to insure that corrosion resistance and strength are not reduced.

Abstracted from Paper 175, "Fabricating Techniques for High-Strength Superalloys" presented at the 26th ASTE Semiannual Meeting. Copies of the complete paper can be purchased from Society Headquarters.

Welding

The fusion welding processes generally used for stainless steel are applicable to the high-strength alloys, with some variations. The choice of the process is determined by alloy grade, metal gage, weldment design, joint design, joint position and special problems incurred in erection or fabrication. For maximum corrosion resistance, weldments should be given a solution type heat treatment after welding. In all instances, the welding surface and adjacent base metal should be thoroughly clean and bright for welding. Foreign materials can be removed by scrubbing with trichlorethylene or other suitable solvent.

Joint Design and Edge Preparation: Many types of joints are used in fusion-welding. The type chosen will not necessarily change with a change of welding process since joint designs are standard. To make joints suitable for automatic welding operations, such as submerged arc or inert-gas shielded-arc, certain slight modifications may be necessary.

High-strength alloys do not have the fluidity of steel during a welding operation. Therefore, when V, U or J-grooves are used for joints, it is necessary to provide a slightly larger clearance than needed for steel. This clearance allows for cleaning and better accessibility during welding. In general, V-joints should be beveled to a 75 to 80-degree included angle, U-joints beveled to a 30-degree included angle with a minimum of a $\frac{1}{4}$-inch bottom radius, and J-grooves should have a 15-degree bevel with a minimum bottom radius of $\frac{3}{8}$-inch. T-joints

Table 1—High-Strength Alloys

Alloy Type	Temperature Limit (F)
Iron base stainless steels	1300
Ni-Mo	1400
Ni-Mo-Cr & Fe-Cr-Ni-Co	1500
Ni-Cr-Fe-Mo	1600
Ni-Cr-Fe-Mo (Al-Ti)	1800
Co-Cr-W-Ni	2000

between dissimilar material thicknesses should have a bevel of 45 degrees. *Fig.* 1 illustrates some of these joint types.

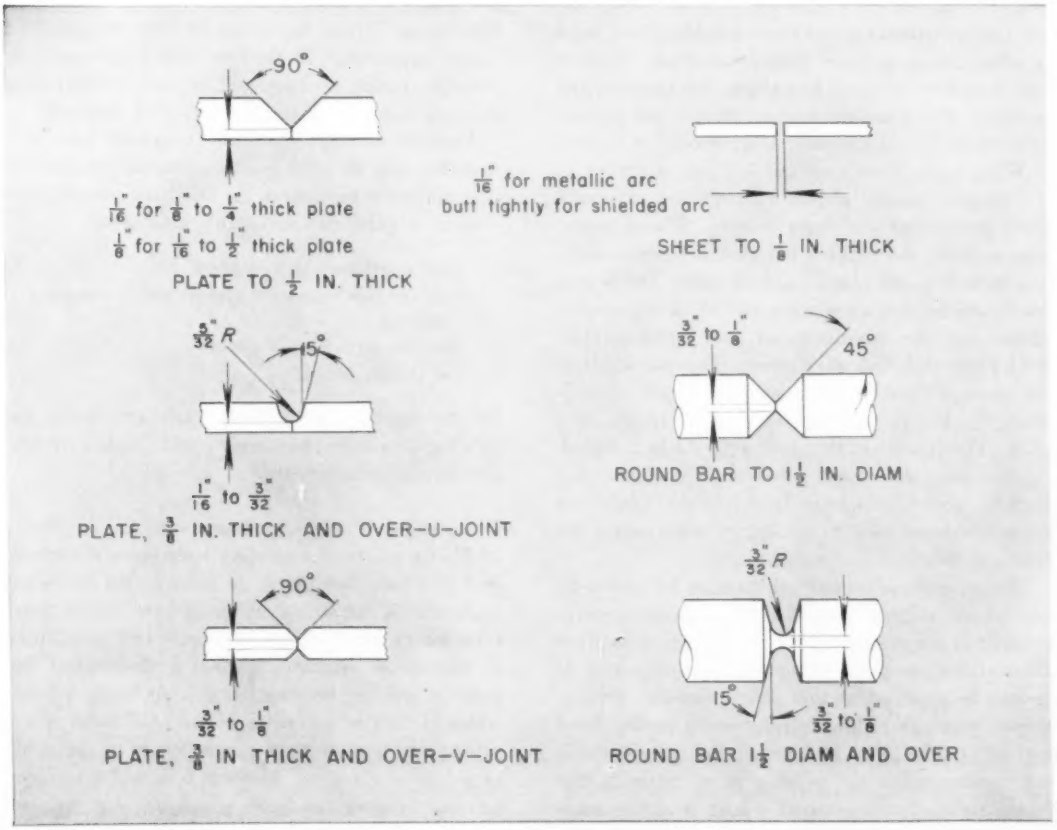
The use of backing rings should be avoided when designing containers or pipe lines for carrying corrosives. Crevices cannot be avoided in this type of design and can become points of cell type and stress corrosion, notch effect and root cracking.

In general, 11-gage or heavier material should be beveled and welded from both sides. When joining material of dissimilar thickness, the heavier section should always be beveled for ease of welding. For material 12-gage and thinner, the welding may be accomplished from one side by using proper edge spacing to allow full penetration. Care should be exercised to eliminate nonuniform penetration. This condition can leave undesirable crevices and voids in the underside of the joint which contribute to areas of accelerated corrosion. Nonuniform penetration in material used for high-temperature applications creates stress risers which are focal points of mechanical failure.

Welding from both sides is recommended wherever possible. When this is not practical, the joint spacing should be increased and a copper backing bar used. Currents slightly higher than normal are required for complete penetration.

Beveling by machine is the surest way to obtain correct fits. A planer, shaper, grinder or other machine tool is best. When sheared sheet or plate is used, the sheared edges should be ground back approximately $\frac{1}{16}$ inch to remove stressed material before the edge is prepared for welding. In all instances, edges should be squared, aligned properly, and tacked before welding. Alignment and edge preparation are particularly important. Any misalignment causes variation in bead contour, gap width and stresses in the weld area. These factors contribute to cracking in weld joints. Since the initial metal cost is fairly high, the slight additional cost of careful preparation to assure good welds is

Fig. 1. Typical weld joints for high-strength alloys.



well justified. Thermal cutting and beveling of plates are not recommended.

Usually, V-joint preparation is used for butt welds in plate thicknesses up to $\frac{1}{4}$ inch and a U-joint for greater thicknesses. The V or U-joint is used where the welded material will be exposed to high stress. When these types of weld construction are used, the stress will act axially. The lap or T-joint may be used for conditions of lower stress. The U-joint preparation is preferred for material greater than $\frac{1}{4}$ inch in thickness. While the cost of preparation may be increased by this type of joint, the amount of welding materials and manhours needed for welding will be much less than if a V-joint is used. Also, the amount of residual stress will be lower since less weld material is required and less transverse shrinkage is incurred.

Jigs and Fixtures: The use of jigs and fixtures for assembly and subsequent welding provides definite economies in reduced welding cost, greater speed in welding and ease of producing welds of uniformly high quality. Proper jigging and clamping of the weld joint make the welding operation easier, and hold buckling and warping to a minimum. It is generally desirable to provide a grooved backing bar of some sort. This serves as a chill to the base material and as a support to excessive hang-through of the weld bead. The use of a backing bar contributes to the ease of welding and helps to obtain more uniform bead penetration. Steel or cast iron may be used in fixtures for oxyacetylene welding. When the arc process is used, the portion of the fixture contacted by the arc should be copper.

When using a backing or chill bar, a groove of the proper contour should be provided to permit good penetration and bead contour. For oxyacetylene welding, the backing bar should be grooved to $\frac{1}{16}$ inch deep and about $\frac{5}{16}$ inch wide. The groove width and hold-down spacing should be adjusted to obtain the best conditions of heat transfer, plate hold-down and ease of welding. For arc welding, the grooves should be of a minimum depth, usually from $\frac{3}{32}$ to $\frac{1}{16}$ inch and approximately $\frac{3}{16}$ inch wide. The corners of the groove should be rounded. Square corners cause poor bead contour, flux pockets, and nonuniform heat transfer. Jigs and fixtures can be used to advantage when using the inert-gas shielded-arc process.

The superalloys considered here can be welded by any of the conventional methods; however, oxyacetylene is not recommended for corrosion-resistant fabrications due to the danger of carbon pickup. It should be emphasized that submerged-arc welding generally results in low-ductility welds having bend factors of only 15 to 20 degrees. Submerged-arc is not recommended for welding heavy plate in the Fe-Cr-Ni-Co alloy because of a microfissuring tendency. TABLE 2 gives recommended amperages and voltages for welding Ni-Mo-Cr-Fe alloy.

In inert-gas shielded-arc welding, electrodes are normally operated at maximum current density in order to obtain best arc stability. It has been found, however, that use of $\frac{1}{16}$-inch-diameter electrodes under these conditions in some cases creates excessive electrode contamination and results in excessive tungsten deposits in the weld puddle. This problem is materially reduced by using a $\frac{3}{32}$-inch-diameter electrode ground to a needle-like point.

Nickel-molybdenum alloy is prone to develop porosity from excess nitrogen and care must be taken to prevent aspiration of air into the weld deposit. Proper joint design and shielding the reverse side of the weld minimize this condition. Inert-gas shielded-arc welding has been generally accepted as the best method of joining materials for corrosion applications. Welds produced by this method are slightly higher in quality than those obtained with the metallic-arc method. Slag inclusions, pickup of stray elements from the coating and excessive burnout of metallic elements in the rod, are not as pronounced.

Consideration of mechanical properties of an alloy before designing the weldment is helpful in determining welding procedure. Most superalloys are "hot-short" between the approximate temperatures of 900 to 1800 F and ductility is reduced in this range. It is important to pass through the temperature range of 1100 to 1800 F as rapidly as possible during cooling, and to design welds in a manner that will subject them to least restraint.

Experience with superalloy materials has been that they can be welded with successful results, but it is necessary to observe the following general conditions to produce satisfactory weldments:

Have a minimum of weld restraint
Keep the base material at approximately room temperature
Maintain good joint alignment
Use stringer beads.

By the application of these basic principles, the welding problems encountered with high-alloy materials will be minimized.

Linings: For lining vessels with the Ni-Mo or Ni-Mo-Cr alloys, the welding techniques illustrated in *Fig.* 2 have been used. In more severe corrosion applications, methods *b*, *c*, and *d* have proved most satisfactory because they eliminate any possibility of base-metal dilution. Method *b* is excellent for position welding because the overlap forms a ledge which facilitates deposition of the weld metal. As a result, this type of weld can be made in the field, as well as in the shop. Methods *b*, *c*, and *d* are economical because the welds which are not exposed

can be made with stainless steel rod or without the addition of filler rod by using the inert-gas shielded-arc process to melt down the edges. Method *d* is a modification of method *c* with wider spacing between the bottom strips. Wider spacing, however, results in a less rigid structure.

The end butt welds are generally vertical and should be staggered as illustrated in *Fig.* 2. When using methods *b*, *c*, and *d*, the butt welds should not be bonded to the base metal but care should be taken to obtain as deep penetration as possible without causing dilution of the alloy weld bead. Methods *a* and *e* are also satisfactory if care is taken in making the final cover weld to prevent base-metal dilution. These are both flat position welding methods, however, and should be made in a shop where suitable fixtures and jigs for turning the vessels are available. The end-butt welds for methods *a* and *e* are made using the same technique as is shown for the edge welds. These end welds may either be made by vertical "up" or vertical "down" welding.

Forming

All high-strength alloys tend to work-harden to a greater extent than do the austenitic stainless steels and as a result require more intermediate stages of deep drawing or cold forming to produce the final part. Again, a study of the mechanical properties of the particular alloy will be invaluable in establishing processing and in designing tooling. Superalloys have higher yield strengths than stainless steel and require greater pressures to deform them. Yield strength does not drop off appreciably before a temperature of approximately 1400 to 1600 F is reached. A 20 to 25 percent decrease in yield strength occurs at temperatures up to 800 or 1000 F but is generally not sufficient to warrant hot working in this lower temperature range. It is impractical to hot work in the temperature range of 1000 to 1800 F because of the "hot-shortness" of the alloys. Because of the difficulty of maintaining temperatures above 1800 F for press forming, deep drawing or spinning, it is recommended that these operations be done cold. Forging is done hot.

Heat Treatment

Each successive cold forming operation should be followed by an anneal. It is also highly desirable to remove scale by pickling the part prior to the next forming operation. All parts should be annealed after final cold forming. If dimensions and accuracy of the finished piece make the final heat

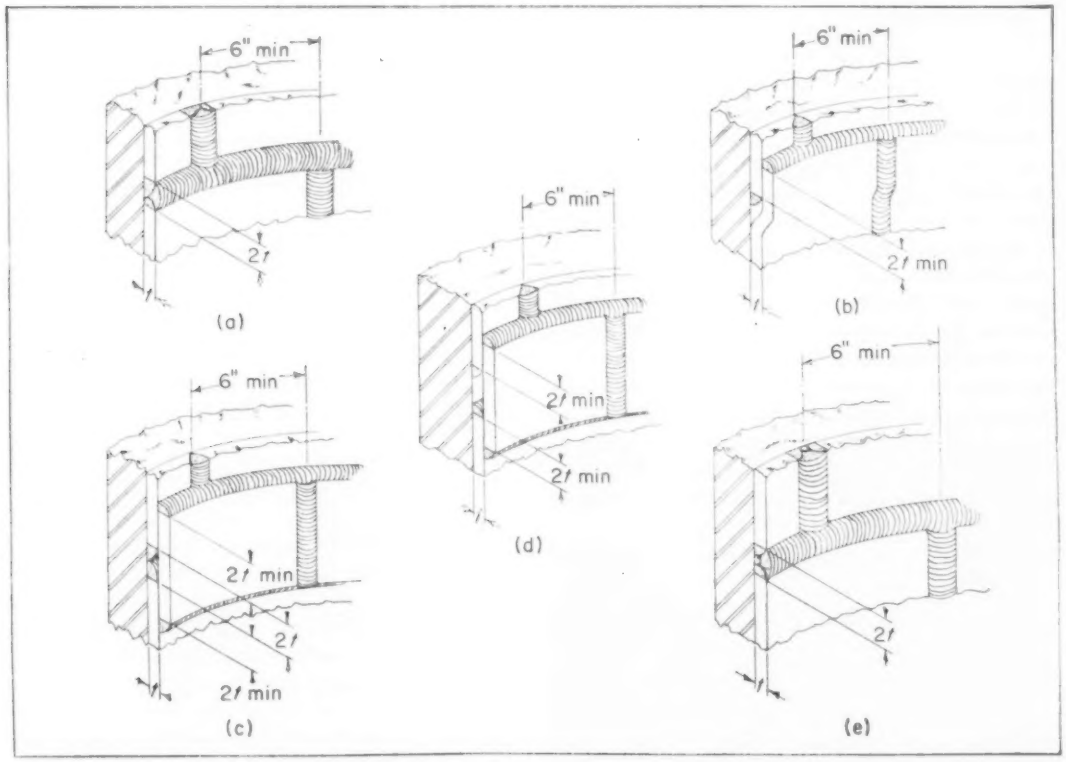


Fig. 2. Types of welds in fabricating superalloy lined vessels. Contamination of the weld bead by vessel material must be avoided for best corrosion resistance. Methods *b*, *c* and *d* with overlaps are preferred.

Table 2—Welding Guide for Ni-Cr-Fe-Mo Alloy

Welding Process	Base Metal Thickness	Rod Diam (in.)	Current (amp)	Argon Flow (cfh)	Speed (ipm)
Submerged-melt	1/4	1/8	275	—	18
	3/8	1/8	300	—	16
Sigma	1/8	1/16	275	30	20
	1/4	1/16	300	35	16
	3/8	1/16	300	35	16
Metallic-arc	—	1/16	40–60	—	—
	—	5/64	50–70	—	—
	—	3/32	60–90	—	—
	—	1/8	80–120	—	—
	—	5/32	90–130	—	—
	—	3/16	110–170	—	—
Inert-gas shielded-arc	1/16	1/16	50	—	30
	3/32	3/32	75	—	30
	1/8	1/8	90	—	35
	5/32	1/8	105	—	35
	1/4	1/8	105	—	35
	3/8	1/8	105	—	35

Table 3—Forging Temperatures for Typical Superalloys

Alloy Type	Forging Temperature (F) Start*	Stop*
Fe-Cr-Ni-Co	2200	1800
Ni-Cr-Fe-Mo	2200	1800
Ni-Mo	2200	1800
Ni-Mo-Cr	2250	1850
Ni-Cr-Fe-Mo-(Al-Ti)	2150	1800
Co-Cr-W-Ni	2250	1850

*Starting temperatures are maxima; stopping temperatures depend on the nature of the work.

treatment impractical, the following procedure may be used: form to as near completion as possible, preferably a minimum of 90 percent of the finished shape, anneal at the solution heat-treating temperature, pickle, perform the final sizing operations.

It is important to realize that temperatures below those recommended for solution heat treating do not restore full ductility. This was emphasized by the recent experience of an aircraft parts fabricator when a problem was encountered in the fabrication of a press-formed part of a Co-Cr-W-Ni alloy. The recommended solution heat-treatment for this material is 2250 F. Circular blanks 6¼ inches in diameter were punched from 0.050 inch thick sheet and in the first drawing operations a cup 4¼ inches in diameter and 1¼ inches deep was produced. The part was then annealed for two minutes at 2150 F (100 degrees below that recommended), after which the hold-down flange was removed and a hole approximately 2 inches in diameter punched in the bottom. In the second drawing operation the bottom of the cup was flared down to produce a skirt approximately ½ inch long. At this point cracks developed in the skirt area. Hold-down pressures were varied from 15 to 80 pounds and other drawing procedures were tried without success. The part was produced successfully only after the intermediate heat-treating temperature was increased.

Descaling

Because of their high alloy content, superalloys are relatively inert to cold-acid pickling solutions. After heat treatment, the oxide film is more adherent than that on stainless steels. Molten caustic baths followed by warm-acid pickling have been found to be most efficient. Both the Virgo (Hooker Electrochemical Co.) and Sodium Hydride (E. I. duPont) methods have been successful. Some slight variations in the bath temperature and time in the bath may be necessary to adjust for variations in chemistry within an alloy group. The Virgo caustic bath is followed by a water quench which washes the caustic solution from the metal. For chromium bearing alloys, the water quench is followed by a three-minute sulfuric acid dip and then a 25-minute nitric-hydrofluoric acid dip, while nonchromium-bearing alloys are given a 25 to 45-minute sulfuric acid dip only. The time will vary with the caustic bath employed as well as with the alloy. Moderately good results have been obtained by pickling the Co-Cr-W-Ni alloy in dilute aqua regia.

Forging

It is important that billets of superalloys are properly soaked before forging. Billets can be charged into the furnace at room temperature, then gradually brought up to forging temperature; or they may be charged into a furnace already at forging temperature. They should soak until they reach a uniform temperature throughout. As a general rule, billets should be soaked one hour at forging temperature for each inch of thickness. A guide to forging temperatures is shown in TABLE 3.

Use of a well-calibrated optical pyrometer is essential. This should be sighted on the piece to be forged when the flame is in the low-fire or off stage. A further check may be made by visually observing the hearth underneath the piece and determining whether its temperature and that of the billet are about equal. Good practice calls for turning the stock frequently to present the cooler side to the furnace atmosphere. Once the billet reaches uniform forging temperature, nothing is gained by further soaking. Direct flame impingement on the

alloys must be avoided. It is also important that fuel of low-sulfur content be used.

Forging should begin immediately after withdrawal from the furnace. Even a very short time lapse may allow surface temperature to drop as much as 100 to 200 F. This will shorten the time available for forging. It is also unsafe, from a forging viewpoint, to raise soaking temperatures to compensate for loss of heat during the transfer.

There are no unusual difficulties in forging high-strength alloys; however, when starting with square ingots, care must be exercised in the initial reduction. This is usually done on flat dies. Freezing of the metal in a square ingot develops a diagonal plane of weakness. Ingots will tend to rupture along these planes if subjected to extreme pressure. Light, rapid blows are recommended until the cast structure is broken up, after which reasonably heavy blows can be used.

No attempt should be made to change the general shape of a billet during the initial stages of forging, particularly when starting with a cast ingot. The alloy should be worked down in the form of a square with equal reduction in both directions. When a square is reached with dimensions across the flats only slightly greater than those of the desired round, the rounding operation may be started.

Rounding can be done by gradually breaking the corners with light blows. This should be continued until the cross section assumes an octagonal shape in which the sides formed by breaking the corners are one-half the width of the original four sides. At this point, it is advisable to change to a bottom die with a 90-degree *V* and retain the flat top die.

By placing the billet in the *V* with the small sides contacting the arms of the *V*, the hammer or press will tend to push the metal toward the center at three points. This compresses the open center structure and minimizes the possibility of center bursts. This may be continued until the billet is worked into a perfect octagon whose dimensions between the flats are equal to the diameter of the finished round. Corners of the octagon are then hammered or pressed down and the billet rounded and sized. To avoid working the metal too severely, it is advisable to use pegs or pieces of metal of known gage size to meter the strokes.

Future Applications

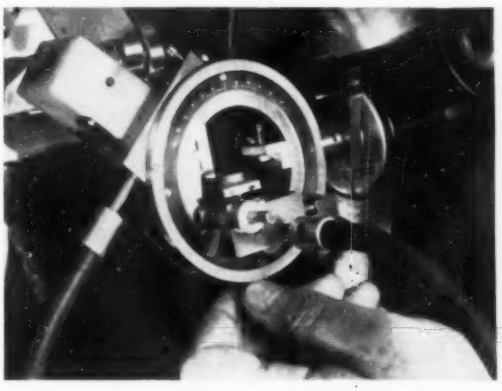
At twice the speed of sound the skin of an aircraft can reach a temperature as high as 500 F due to air friction. At four times the speed of sound the skin temperature may go as high as 1700 F, depending on the altitude. Superalloys, now used extensively for turbine wheels, afterburners and tailpipes will be used in the future for construction of the entire fuselage of aircraft and missiles in order to combat these aerodynamic heating effects. Knowledge of fabrication techniques in use now will be a valuable assist in extending the use of superalloys to new fields and new products.

X-Ray Yield Quality Control Data

To assure optimum composition and structure of its steel products, Wallingford Steel Co. is utilizing X-ray in routine material tests. Through this technique, exact chemical makeup of each coil of steel or alloy can be determined. A Norelco X-ray Spectograph is used to determine percentages of all essential elements except carbon which is checked by combustion methods. Comparison of the unknowns is made to an extensive set of standards that Wallingford now has accumulated, and the engineers consider results more accurate than those possible with wet chemistry.

In processing certain metals, forming characteristics and preferred orientation can be correlated to provide an effective quality control method. X-ray diffraction can establish correct processing to obtain desired orientation. Once plant procedure is set up, the same X-ray methods are used to evaluate finished material in routine quality control tests.

Efficient routine minimizes time required for the work. Specimen preparation requires less than two minutes, while actual X-ray analysis is completed in something less than three minutes per element.

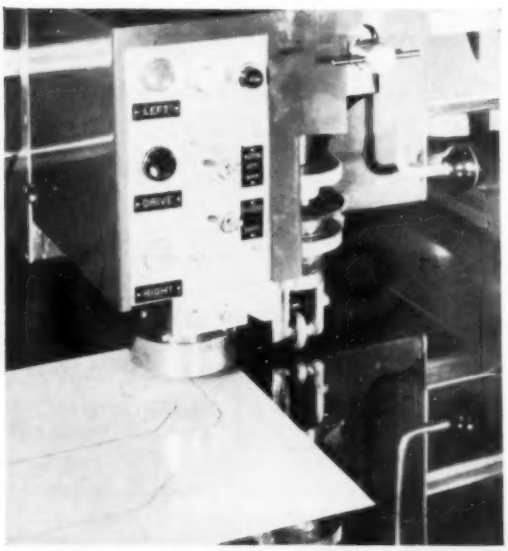


Close-up view of specimen mounted at center of graduated ring which is employed for preferred orientation studies.

designed for

PRODUCTION

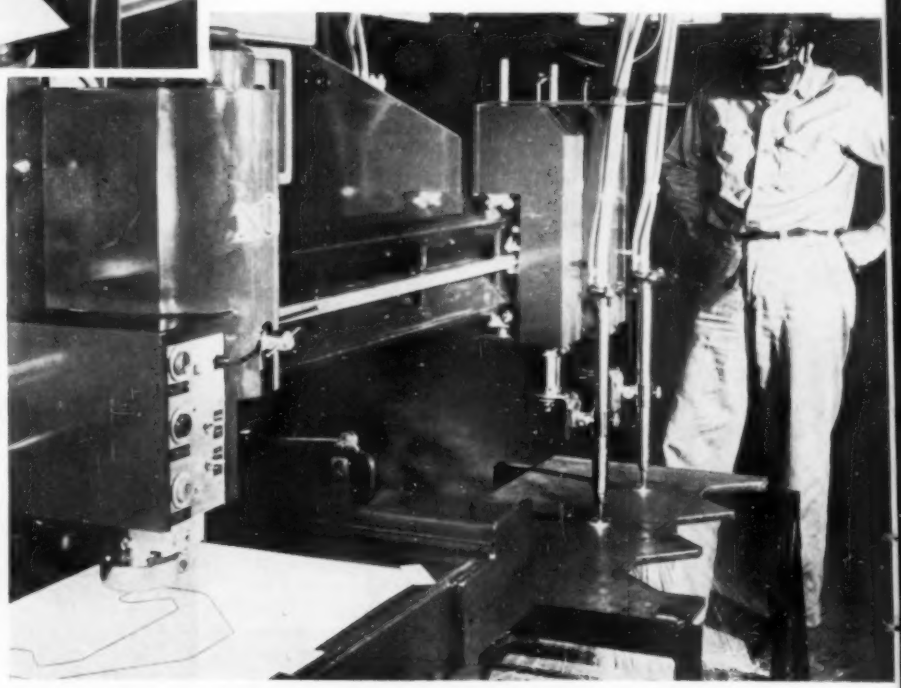
Electronic Line Tracer Guides Flame Cutting Machine



CLOSE-UP of the electronic scanning head with unit in operating position over a part drawing.

With an adaptation of an optical sensing system, developed by Canadian Westinghouse Co., Ltd. for the National Cylinder Gas Div. of Chemetron Corp., metal-cutting torches are steered by scanning pen or pencil line drawings.

The line tracer head has a vibrator type scanner with a phototransistor as a component of a closed loop servo system. Mounted on a regular motor-driven tracing head of a flame-cutting machine, the tracer follows the exact center of a line drawing to direct torches in cutting the same pattern from a plate of steel. Drawings use pencil or pen lines no more than 0.040 inch wide in any combination of dark or light colors between which the photo-cell can discriminate.



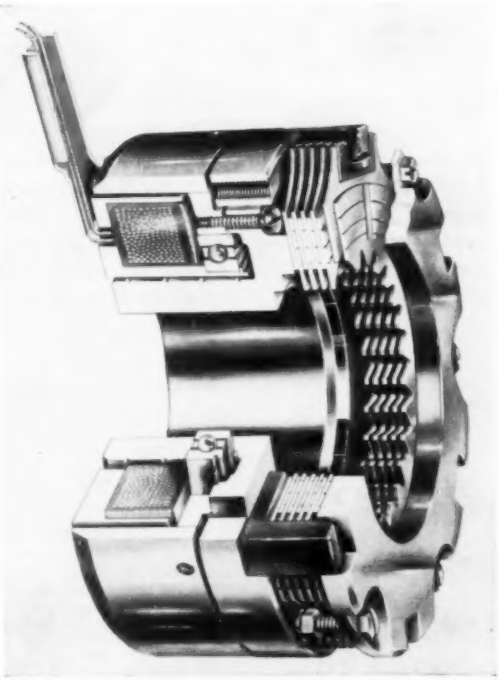
ELECTRONIC TRACER on a flame cutting machine following a line drawing on the scanning table. Two torches are guided by the scanning head to produce duplicate parts from the line drawing. Corners with radii as small as 3/32 inch can be followed by the unit as well as being able to cross lines.

Stationary Field Coil Operates Electromagnetic Clutch

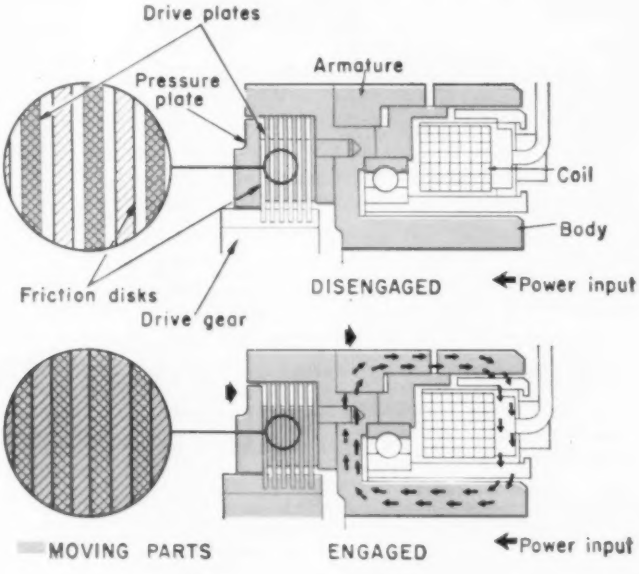
New high-speed machine tools require clutches which respond instantly to their controls. By isolation of the electrical assembly from the friction clutch components, an electromagnetic clutch, developed by Fawick Airflex Div. of Fawick Corp., reduces the decay time or "drag" due to residual magnetism during disengagement. For a typical model, torque build-up time to attain 90 percent capacity is 0.198 seconds, with a torque decay time of 0.052 seconds. Current input to the field coil affects torque capacity, time of engagement and time of disengagement.

During disengagement, the coil shown in the illustration, remains stationary while the body and armature rotate as an assembly attached to the power input shaft. At this time, the friction disks and the drive gear remain idle.

When the coil is energized, a magnetic flux circuit is set up which attracts the armature which has the pressure plate bolted to it. This action causes the driving plates to be bound into a full friction coupling with the driven disks transmitting power to the drive gear. The magnetic flux circuit is designed so that flux does not pass through the driving or driven plates which eliminates magnetic attraction between disks and plates.



CUT-AWAY SECTION of the clutch showing location of the stationary field coil.

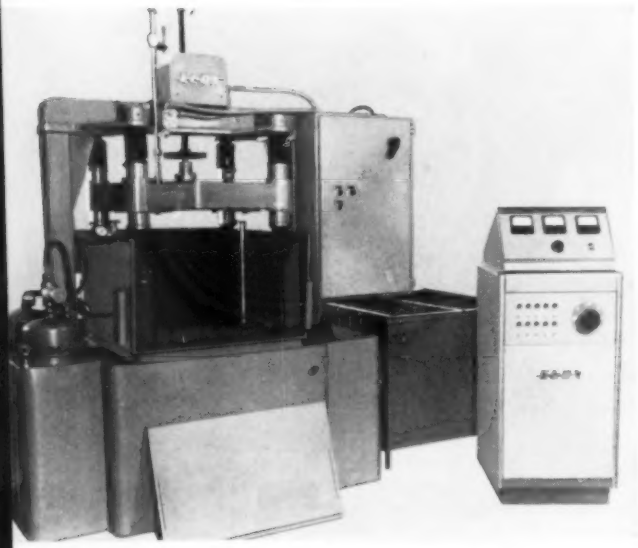


SCHEMATIC DIAGRAM of the Fawick magnetic clutch and its magnetic flux circuit during operation.

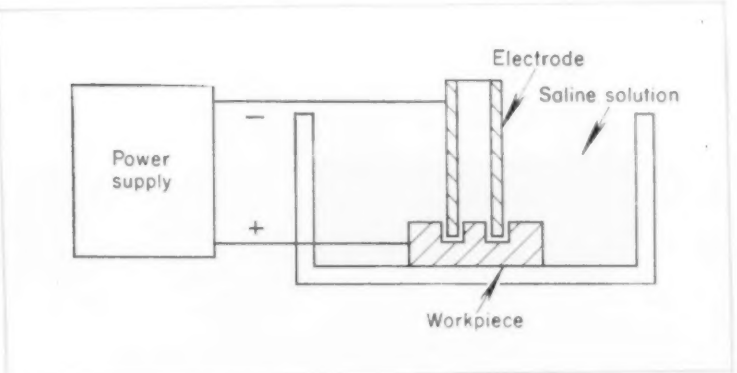
Metal Removal Rates Increased By Electrochemical Machining

When machining dies, electrical discharge machining is useful for making intricate shapes. Its low metal removal rates on hogging operations, however, often made it impractical. A new process, called electrochemical machining, has been developed by the Elox Corp. of Michigan which uses electrodes of any conductive material such as lead, tin, zinc or even solder so that electrode preparation is minimal. Wear on the electrode is so little that electrodes can be reused many times, reducing the cost per cubic inch of metal removed.

Briefly, the process uses an electrode similar to ones used for electrical discharge machining, but both electrode and workpiece are submerged in a saline solution. Metal is removed by electrochemical action controlled by a sensitive servo-feed system that advances the electrode into the workpiece as machining progresses. Typical metal removal rate, using a 5000-amperes power supply, is 30-cubic inches per hour with a minimum electrode area of 100-square inches. Using a 50,000-amperes power supply, 300-cubic inches per hour with a minimum electrode area of 1000-square inches are removed. The rate of metal removal is proportional to the capacity of the power supply.



ELECTROCHEMICAL machine used for jobs requiring large quantities of metal removed. In operation, the front cover is clamped into place and the saline solution is pumped from the storage tank located behind the machine.



SCHEMATIC diagram of the electrochemical process.

ultrahigh-speed machining ...panacea or pipedream?

By A. O. Schmidt*

Chief Engineer, Metal-Cutting Research
Kearney & Trecker Corp.
Milwaukee, Wis.

There has been much interest in ultrahigh-speed machining of high-strength aircraft materials. After evaluating pertinent test data in metal-cutting and related fields, the author concludes that high-speed butter will not cut high-strength alloys. An opposite view was presented by Robert L. Vaughn in the October issue.

WITH THE INTRODUCTION of high-strength aircraft materials, high-speed machining has been the subject of many interesting speculations—speculations that have not always been supported by machining tests, *Fig.* 1. These speculations are based on an intriguing proposal made by C. Salomon[1] in 1931. His findings, *Fig.* 2, are based on thermocouple measurements in high-speed milling tests. At first sight, the findings definitely seem to indicate that at higher cutting speeds there is a drop in temperature. Therefore, it may be possible to machine faster and also increase tool life after getting "over the hump" or through the "valley of death."

Why Salomon Was Wrong: The Salomon graph has been discussed in many languages and is the basis of more speculations than any other claim in metal-cutting literature. It has been pointed out by Opitz[2], however, that the curve of thermoelectric emf versus cutting speed obtained with a tool-work thermocouple turns downward when speeds above those at which the workpiece metal melts have been reached.

A graph based on some of Salomon's tests results is shown in *Fig.* 3. The apex of each curve occurs near the melting point of the workpiece material, which will be close to the melting-point temperature at the tool-chip interface. These temperature values were determined from measurements of specific thermoelectric emf values presumed to correspond to specific temperatures.

However, whenever the melting-point of one of the metals in a thermocouple is reached, thermoelectric emf values do not follow the relation associated with temperatures below that point. The emf

[1]**Numerals refer to bibliography at end of article.**

***Senior member ASTE Milwaukee chapter.**

From Paper 139, "New Milling Techniques," presented at the ASTE Semi-annual Meeting. Copies of the complete paper are available for purchase from Society Headquarters.

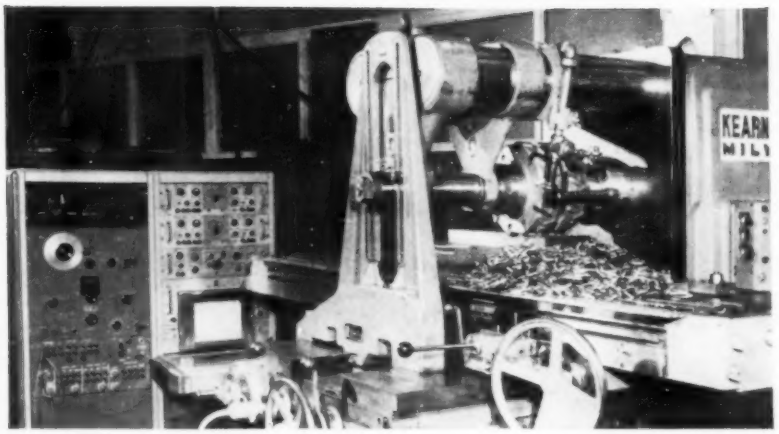


Fig. 1. Equipment used to determine tool life when cutting superhard materials. With this setup, SAE 4340 steel, hardened to 500 Bhn was cut at 25 fpm with 0.5-ipm feed. Depth of cut was two inches; width of cut, four inches. The cutter usually lasted for one pass.

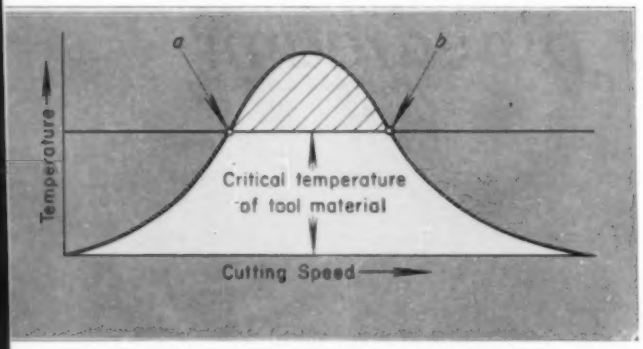


Fig. 2. Theoretical diagram showing the influence of cutting speed on variations of tool temperature according to C. Salomon. The zone between *a* and *b* is the "valley of death" where tool failure occurs due to high temperatures. Beyond *b*, temperatures decrease as cutting speeds increase.

tends to drop with a further increase in temperature, since the thermocouple has been basically changed by the melting of one of its elements. The relationship of emf to a range of temperatures has been plotted by A. Schulze[3]. His graph shows that at speeds causing melting at the tool-chip interface, the decrease in thermoelectric emf of the tool-work thermocouple indicates an increase in tool-chip interface temperature rather than the decrease predicted by Salomon. The temperatures indicated in *Figs.* 2 and 3 are valid only to the left of the curve zenith. Temperatures to the right of this point (at very high speeds) actually may be above the melting point of the work material but the emf drops.

In an article[4] appearing several years ago, Salomon's data were used as a basis for the contention that cutting speeds in practice are far too low. Under certain limited conditions[5], e.g., light cuts with small chip thickness and a low percentage of time in the cut for the cutting edge, milling and turning can be successfully accomplished at higher than normal speeds. However, for the larger chip cross sections and metal-removal rates generally encountered and economically necessary in milling and turning, such speeds are impractical. Tool life is extremely short.

Tool Life: When machining steel with carbides at a depth of 0.150 inch and a feed of 0.010 inch per tooth or per revolution, a tool-chip interface temperature of 2600 F was reached within a short time at cutting speeds above 1000 fpm. When cutting a mild steel workpiece at 15,000 fpm a burned surface and completely ruined carbide tips, *Fig.* 4, were convincing evidence of complete failure after less than one pass. The machine used was especially developed for high-speed machining of light alloys which, due to their low specific cutting energies, can be cut at much higher speeds than ferrous materials[6].

Another problem associated with high-speed machining is high-speed spindle design. Dentists use carbide drills about $\frac{1}{16}$ inch in diameter, cooled by a stream of water, at 150,000 rpm or approximately 2500-fpm cutting speed. Not much torque can be delivered by such spindles. When removing large amounts of chips from a piece of hardened steel (500 Bhn) machinists usually have to resort to low cutting speed and a rigid setup as illustrated in *Fig.* 1. The 11-inch-diameter cutter has HSS blades. Despite use of a 4-inch-diameter arbor and a rigid machine tool, deflections are seen with the unaided eye.

The effects of various cutting speeds on the tool life of tungsten-titanium carbide teeth are shown in *Fig.* 5. SAE 1020 steel (180 Bhn), was face milled at 0.150-inch depth of cut and 0.010-inch feed per tooth until average wear of $\frac{1}{32}$-inch width appeared on the peripheral clearance surfaces of the blades or until failure by breakage occurred. Best results (120 cubic inches of chips removed), were obtained at a 600-fpm cutting speed, with a terminal width of peripheral flank wear of 0.030 inch. The same carbide tips failed sooner after removing a lesser volume of chips at faster cutting speeds, due to in-

creased rate of wear at the higher tool temperatures. This failure was caused by abrasion. At slower cutting speeds, tool failure was most frequently caused by flaking and chipping of the carbide tips.

When milling a hardened steel workpiece (400 Bhn) the carbide tool life was very short when cutting at 428 fpm with a feed of 0.0115 inch per tooth.[5] With the same setup and cutter but a cutting speed of 130 fpm and a feed per tooth of 0.0045 inch, the operation was successful as shown in *Fig.* 6.

To overcome difficulties encountered in machining hardened materials, certain aircraft structures of alloyed tool steels have been machined in a relatively soft condition and subsequently heat-treated in restraining fixtures to develop high hardness and tensile strength with minimum distortion.[7]

Explosive Machining: The latest proposal in the field of a high-speed machining of the harder alloys is to use a propellant to fire a workpiece past a carbide tool. Several experiments of this kind have been reported.

Various machining problems and techniques for shaping new materials used in supersonic airplanes have been discussed by A. H. Petersen.[8] From his statements it can be seen that, when these new aircraft are beyond the prototype stage, the task of the tool engineer to provide tools, machines and other procedures for making parts in sufficient quantities will be of great magnitude.

Chemical milling, electrical-spark machining and electrolytical methods will have their place in machining these new alloys. The question of what to do when large amounts of metal have to be removed economically from a workpiece with high physical properties is still unanswered.

Petersen reports the use of a rifle to propel a workpiece slug across a tool at ultrahigh speeds. Probably many tool engineers have looked at their guns and have tried to figure out a safe mechanism which would permit pushing a carbide tool over the surface of a jet engine alloy. Any high-speed experiments of this kind can be dangerous if undertaken without the proper equipment and precautions.

It has been stated by aircraft designers[8] that within a few years manned flight vehicles will have a surface temperature of 1200 F. If an aerodynamically well-shaped body attains such temperatures, even higher temperatures can be anticipated with a poor aerodynamic shape such as that of a tool moving through steels and special alloys at the same speed as a fast airplane. There is no reason to believe that a "thermal thicket" exists in a fluid such as air, but not in a solid such as steel.

Projectiles as Cutting Tools: Machining high-strength alloys at high cutting speeds approaches conditions similar to those of penetrating armor plate with a carbide projectile. The use of carbide cores in armor-penetrating ballistic missiles began during World War II. The advances in cutting tools and increases in cutting speed find a close parallel in the development of guns and increases in projectile velocity.

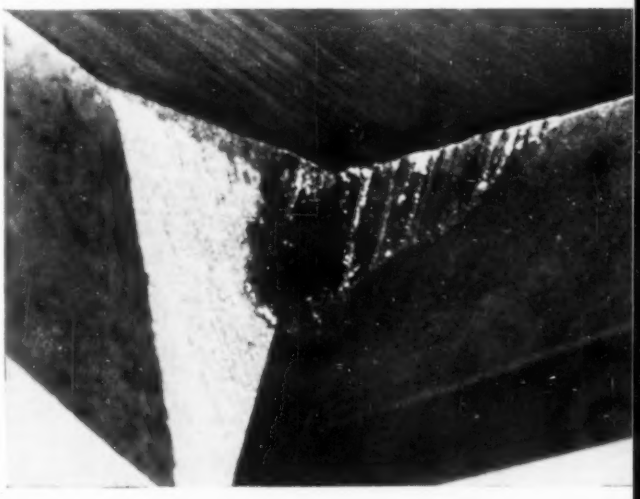


Fig. 4. (above) Flank wear and cratering on carbide tip used for milling at 15,000 fpm.

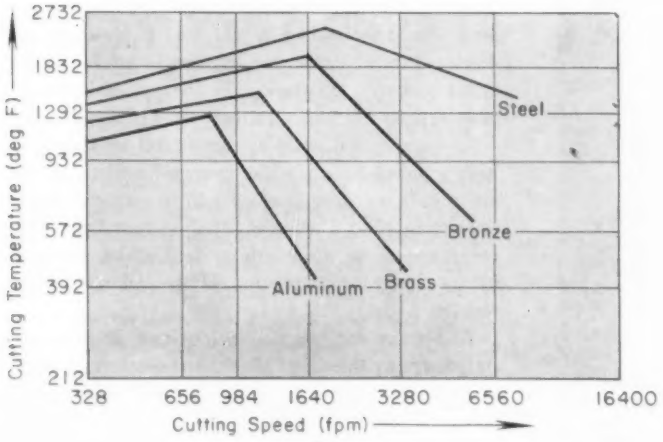


Fig. 3. (left) Cutting temperatures versus cutting speed, according to Salomon.

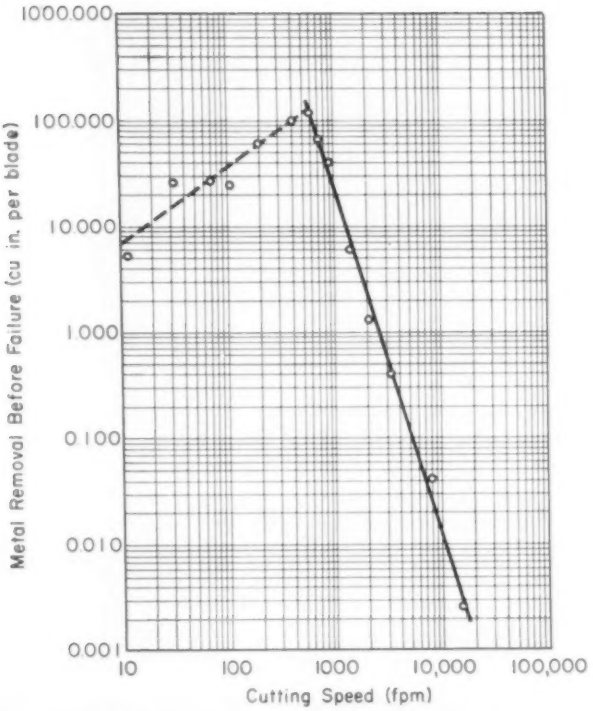


Fig. 5. Effects of cutting speed on tool life, as measured by metal removed before tool failure.

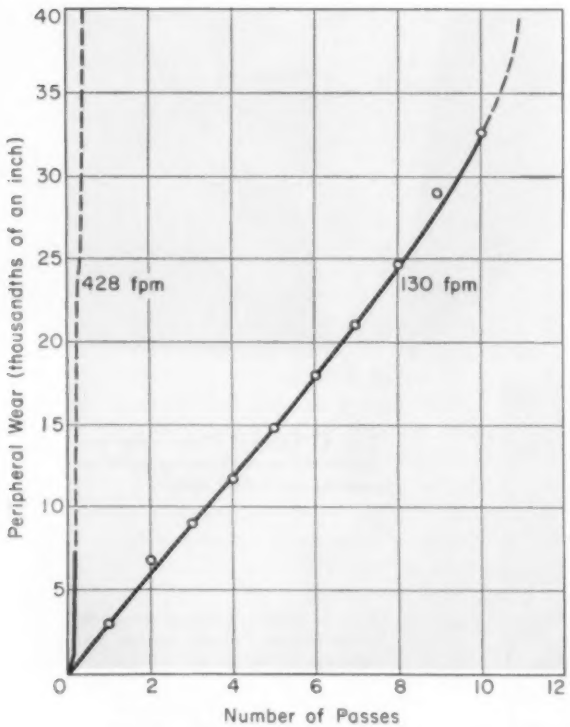


Fig. 6. Increase in peripheral wear on carbide tip when milling hardened (400 Bhn) steel. Dotted lines indicate chipping.

It is profitable in this connection, to study some of the wartime research reports[11]. In Germany, the scarcity of tungsten carbide forced abandonment of armor-penetrating, tungsten-carbide-core projectiles. Heat-treated projectiles of ordinary steel were developed for the penetration of armor plate at long ranges. A "super gun" with a 6-inch caliber was built. This gun produced a muzzle velocity of 4500 fps when firing a 150-lb projectile. The barrel was made up of sections and 28 powder chambers were arranged along the bore. Successive explosions progressively boosted the speed of the projectile in its course through the bore. Although the barrel exploded once in every three shots, the gun was considered successful because it was comparatively easy to replace the blown-up section.

Actual service life of conventional guns has decreased with the increase in muzzle velocities. Two hundred rounds can be fired with a 16-inch gun and only about 700 rounds with a medium-size gun. Gun life has been extended by employing chromium plating in the bore of a steel barrel and by the use of stellite or other special alloys for the barrels.

American research on increasing projectile velocities[12] was extended to 5500 fps. This research completely disproved a statement found in one ordnance book: "If very high striking velocities are obtained, penetration is little affected by the material of which the projectile is composed."

It was shown that deformation of projectiles increases progressively with increased striking velocity. At the top of the speed range the nose of the projectile (tool) completely disintegrates because the energy absorbed by the armor plate (workpiece) increases tremendously. The energy of a projectile is a function of the square of the velocity. To obtain high velocities, a projectile should present a small cross-sectional area to the air, in order to reduce air resistance. The tendency in gun development has been toward higher muzzle velocities and also larger calibers to penetrate harder and thicker armor plate. If higher speed alone were sufficient to provide the necessary energy to penetrate heavier armor plate, the caliber of antitank guns might still be 37 mm, as it was at the end of World War I. Research has disclosed that "high-speed butter will not beat high-grade armor." Shattering of the projectile is the most serious limitation to the use of high velocities.

As long as 200 years ago investigators associated higher speed in air with increased resistance. In his report on principles of gunnery to the Royal Society in 1746, Benjamin Robins[9] stated that "the resistance of the air within certain limits, is nearly in the duplicate proportion of the velocity of the resisted body."

Within the last few years there have been serious statements to the effect that the resistance of high-strength materials to penetration would be no more than, and possibly less than, that of air, if only tools

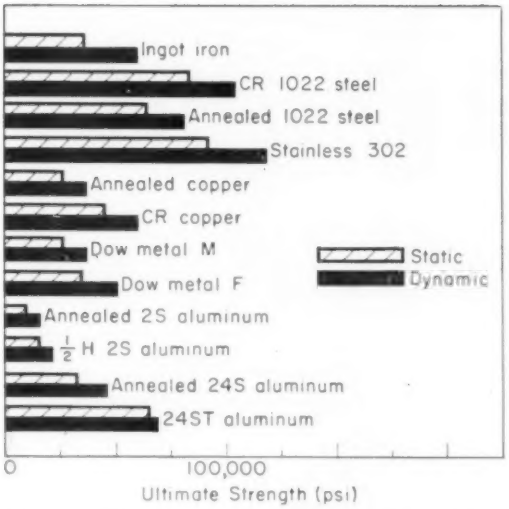


Fig. 7. Static and dynamic values of the ultimate strength of several materials.

would be made to go through the metal fast enough. We might just as well propose to build Sputnik type machine tools, the nose being the cutting tool. Some such limits were actually made at the 1958 ASTE Annual Meeting in Philadelphia during the discussion of a related paper[10]. Well, we haven't been able to overcome all the obstacles to super high-speed machining in Milwaukee and we don't think it can be done in other places in this country or Russia.

Materials under Impulsive Loads: When machining operations are conducted at very high cutting speed, especially in milling, the operating conditions are similar to those encountered when applying a sudden load of short duration. The behavior of metals under impulsive loads has been studied and reported comprehensively by J. S. Rinehart and John Pearson.[13] They encountered failures that ranged from minor grain distortions to extensive flow and fracturing.

A difference exists between the performance of metals under static and dynamic conditions of loading. Clark and Wood[14] used a rotary tensile impact machine capable of maximum impact velocities of between 12,000 and 15,000 fpm. A comparison of static and dynamic values of the ultimate strength of various materials is shown in *Fig.* 7. The dynamic strength of a workpiece is greater than its static strength. This factor must be taken into consideration when machining at high speeds, since the difference is great enough to influence machinability.

As yet no "wonder" cutting fluid, no "miracle" tool material, no "atomic disintegrator" or "magic angle" has been discovered which will automatically result in high, accurate production and do away with exacting tooling requirements.

Although cutting speeds used when machining high-strength alloys seem to be unduly slow, current developments should overcome some of the difficulties. It took almost 10 years for industry to learn how to use carbides for the machining of cast iron. At least another five years of experimentation in laboratories and shops were required to establish procedures and reliable data for carbide steel milling. Cutting speeds, feeds, tool angles, tool design, machine-tool requirements and mounting of workpiece had to be determined experimentally.

Today machining of steel as hard as 400 Bhn is a routine procedure in numerous production shops. On the basis of this experience plus the improved machine tools and tool materials of today and the availability of better instruments for the analysis of machining factors, industry is well-equipped to overcome some of the new difficulties arising when machining high-strength alloys. A systematic approach using novel experimental techniques such as confined hot machining, faster spark machining, and newly developed tool materials, together with theoretical studies, will make possible further advances.

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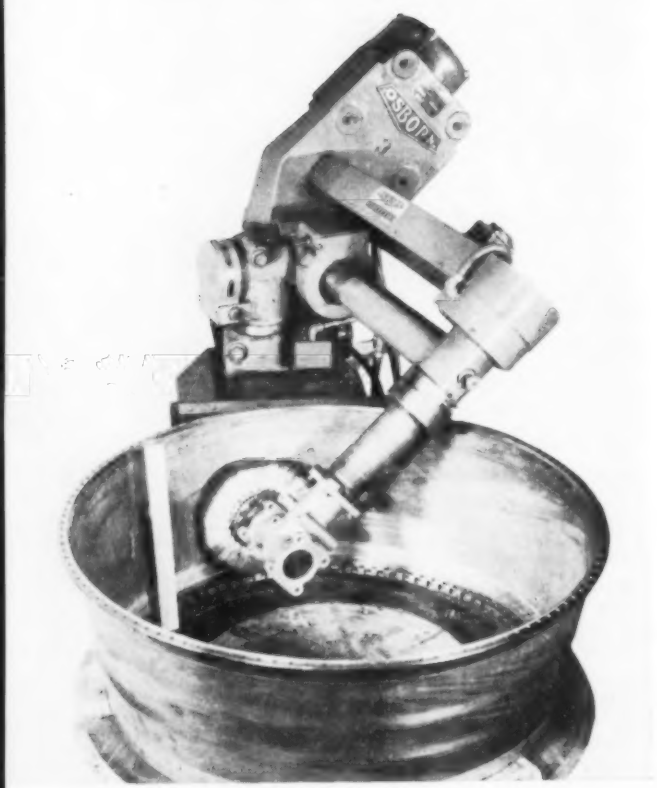
POWER BRUSHING
for finishing without burrs

Power brushing eliminates machining marks and burrs which are sources of stress concentrations. Parts are improved in finish and manufacturing costs are reduced. Typical examples of before and after conditions illustrate the potentialities of the method.



POWER BRUSHING is being used by many manufacturers to remove stress-raising scratches and tool marks. Investigators have found that a sharp corner or edge may reduce the endurance limit of a part as much as 50 percent. A distinct V-notch, such as one made by a hard tool, may reduce the endurance limit as much as 60 percent.

Hundreds of hours have been spent on aircraft engines for tedious hand filing operations. Literally each tooth, groove and surface on hundreds of parts have been finished in this manner. Recognizing the magnitude of the problem, Osborn Mfg. Co. engineers, working with engineering personnel of major engine manufacturers, were able to replace the slow, costly hand method on the most critical jobs with power brushing methods, *Fig.* 1. Brush finishing may be integrated with manuafcturing operations to advantage. Product uniformity is im-

Fig. 1. Typical brushing setup for finishing jet engine case components. The heads automatically position the fiber brushes to finish the inner and outer surfaces of the ring.

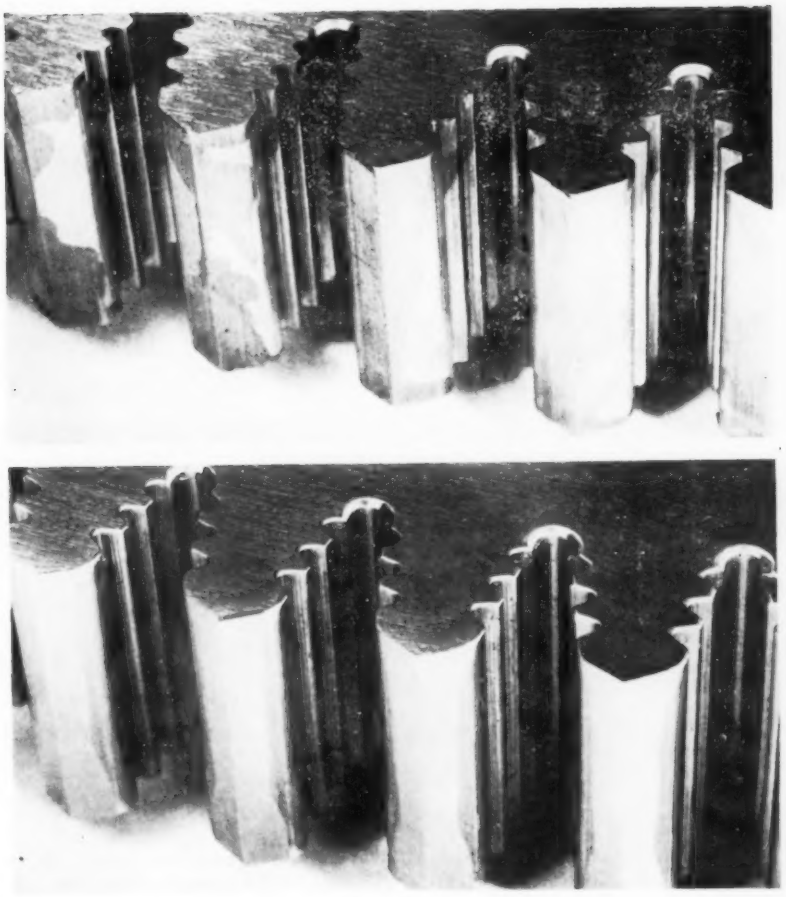


Fig. 2. Aircraft turbine disks sections after the slots for holding the blades have been finished. Before the brushing operation, the disk (top) had sharp corners and burrs. The same disk (bottom) after power brushing removed the stress concentrating edges.

proved, manufacturing costs are reduced and production finishing operations become standardized.

Brushing removes most burrs. It does not produce a secondary burr or create two sharp edges in place of the one removed, as in many other deburring methods. A uniform finish with a surface refinement of 8 to 10 microinch rms can be obtained as opposed to the erratic surfaces obtained with hand methods.

While removing burrs, the brushes simultaneously produce the smooth surfaces and rounded edges which blend joining surfaces. The correct flexible nature of properly specified brushes enables them to blend tool and grinding marks into the surrounding surfaces. The number of stress focuses, often responsible for fatigue failure, are reduced. During this distribution of stresses, blending of sharp markings is the first consideration and smoothness may or may not be required.

Although power brushing has long been accepted as a finishing method, equipment for finishing large aircraft components has not been available. A new series of Osborn machines, however, called Brushamatic 51 has been developed for parts 12 inches or larger in diameter which weigh up to 50 pounds. One manufacturer reports total savings of over 684 minutes for finishing three stages of turbine disks. With previous hand methods, which consisted of filing and emery rubbing, an operator turned out two finished pieces per day. Now, the same finishing job on both sides is completed in 12 minutes, floor to floor. Not only is there an increase in production but, based on the quality attained by brushing, the former hand-finished parts would not have passed inspection.

The operation of the machine was easily learned by an unskilled operator after a short training period. Table and part rotate at a predetermined speed and a preset timer determines the cycle for retraction of the brushes. The amount, direction and quality of brushing received by each part is predetermined and set into the machine. Loading, unloading and occasional adjustments for brush wear are the only manual operations required.

On the turbine disks, illustrated in *Fig.* 2, brushes finish the two edges of the "Christmas tree" roots and the OD. The brushes are positioned to cross the sides of the roots at the proper angle. A wider

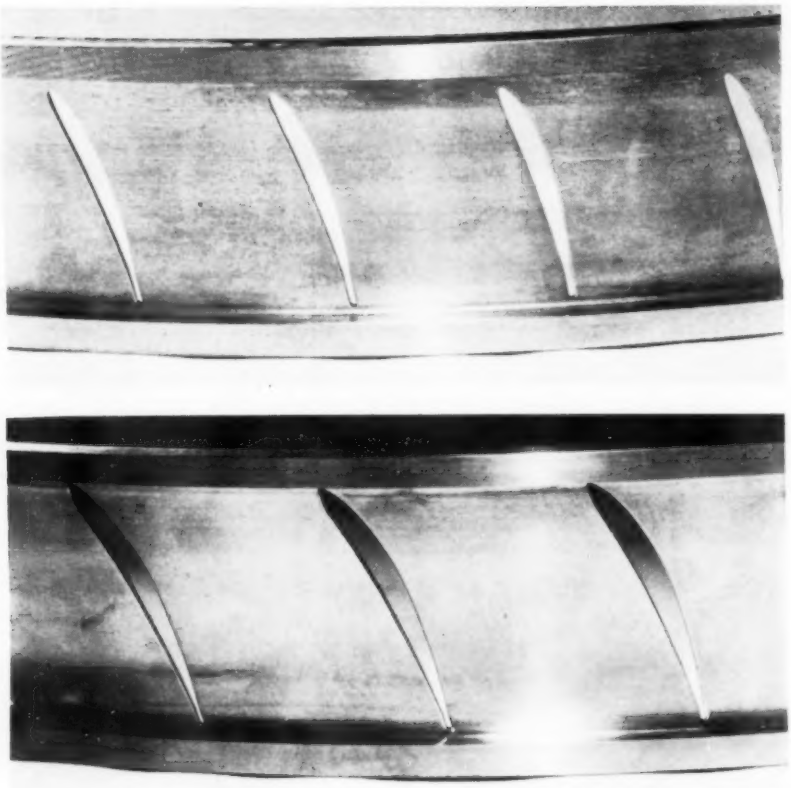


Fig. 3. Parts were brushed to obtain the desired surface finish and remove tool marks. Conditions of before brushing (top) and after brushing (bottom) are illustrated.

face brush is used on the OD. Brushing takes about four minutes on each side, with the OD being brushed only during the finishing of one side.

In this same plant, savings of over 130 hours per jet engine have been realized using the same techniques of finishing on the 16 compressor disks. Prior to power brushing, eight hours were consumed per disk in the hand-finishing operations. These components are now brush finished to a 10 microinch rms finish in 42 minutes per disk, including preburring work.

To perform this operation, one brushing head is set at angle to finish the inside diameter of the tang. Another head finishes the top of the tang, while a third head finish brushes the OD. Brush pressure is preset and the operator is notified of brush wear by a meter. Constant pressure on the workpiece is maintained by adjusting the meter reading on the control panel for the proper load conditions.

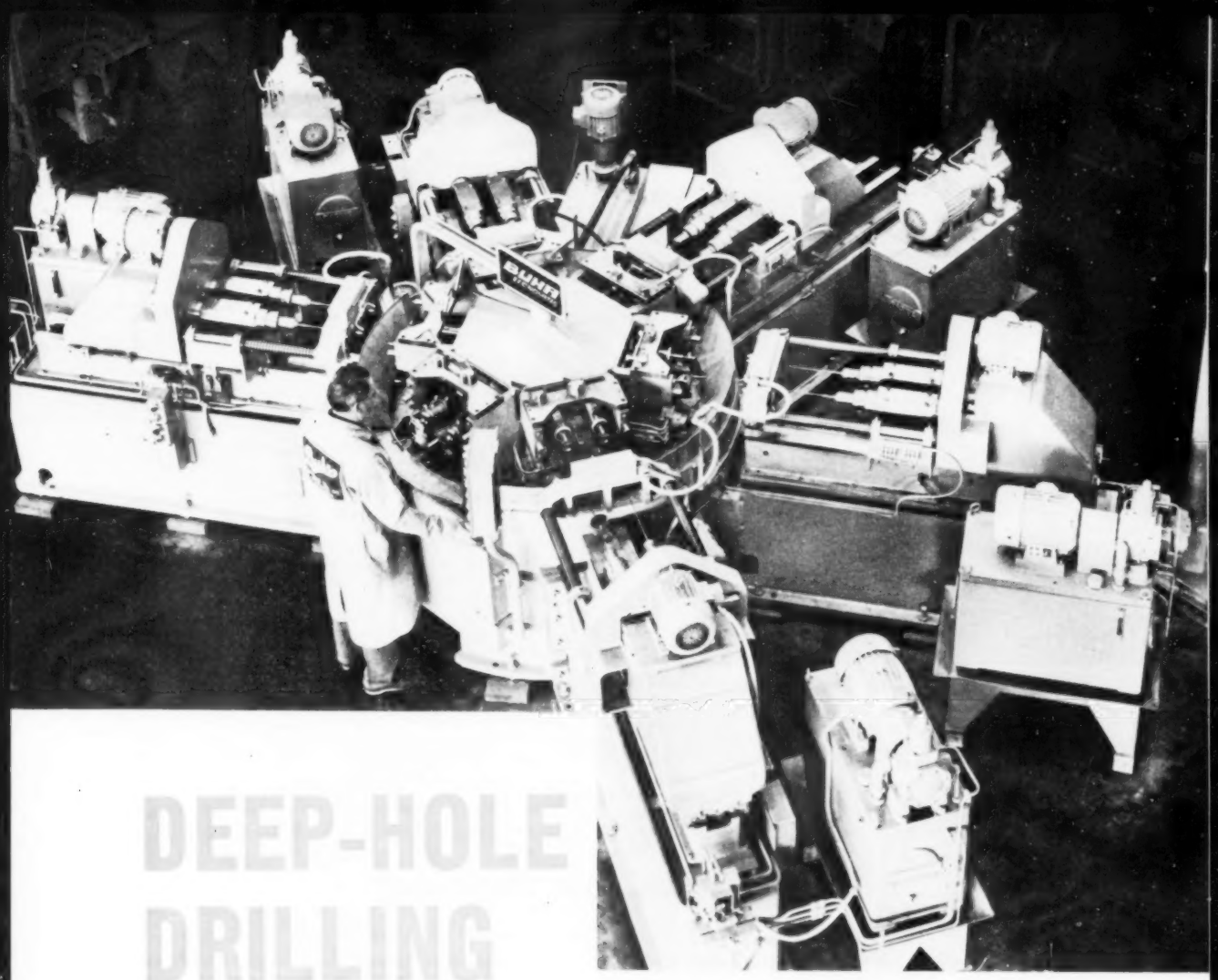
Jet engine shrouds are other parts finished by power brushing. The part is placed on the holding fixture and the brush heads are positioned over the "banana slots." With this brush setup, production time per engine was reduced by 418 minutes when compared to the former hand-filing method of finishing. Before and after conditions on a shroud ring are shown in *Fig.* 3.

The turbine blades that go into every engine must have fine finishes for efficient operation. Size and surface finish of the root must be held to exacting precision for assembly and to attain the highest ultimate strength. Again, prior to the development of automatic finishing methods, hundreds of hours, and therefore, thousands of dollars, were spent on hand-finishing operations.

With power brushing, blades are mass-precision-finished quickly, easily and completely. During the operation, eighteen blades are set into a special fixture by the operator. This fixture has a nest for the blade that keeps the root end protruding, and a clamping device for holding the blade in place during the cycle.

Two heads brush the blade roots, while a third head brushes the pin slot of the blade. All the minute burrs on the root end are removed; surface junctures are blended, eliminating sharp corners where stress concentrations might occur.

Brushes and brushing machines have been found to fit particularly well into the manufacturing operations where the ratio of labor costs to other production costs is high. In the case of one company, labor and time savings have permitted an amortization period of only eight months per machine. With such savings possible, power brushing applications will be developed to extend the use of the process to other fields of manufacturing.



DEEP-HOLE DRILLING with standard twist drills

By Michael Zajac
Vice President, Engineering
Buhr Machine Tool Co.
Ann Arbor, Mich.

Before deciding to drill deep holes with twist drills, a tool engineer must consider equipment cost, expendable-tool cost, run size and required accuracy. The author describes development of a method to drill a deep hole in five separate steps with an equal total cycle time for each independent machining head.

Fig. 1. Each of the five hydraulically fed heads in this index drilling machine has a cycle with the same total time but different for operations within the cycle. All heads are withdrawn simultaneously so the dial can index without delay.

WITH A LARGE NUMBER OF PARTS to process, a manufacturer of automobile steering gear housings wanted an automatic machine to drill oil passageway holes in malleable-iron castings. The large volume of parts reduced the importance of the first cost of the machine relative to the combined effects of drill costs per piece, tool maintenance and machine down time. An automatic machine, designed to these specifications, is now in operation, *Fig.* 1.

Before starting on the design of such a machine, it was necessary to make several decisions. The first decision, in this case, on which all later decisions hinged, was the choice of stock twist drills to give the lowest tool cost per piece.

This choice, and the size of the hole in the malleable-iron workpiece, immediately set ranges for rate of infeed and surface-cutting speed. However,

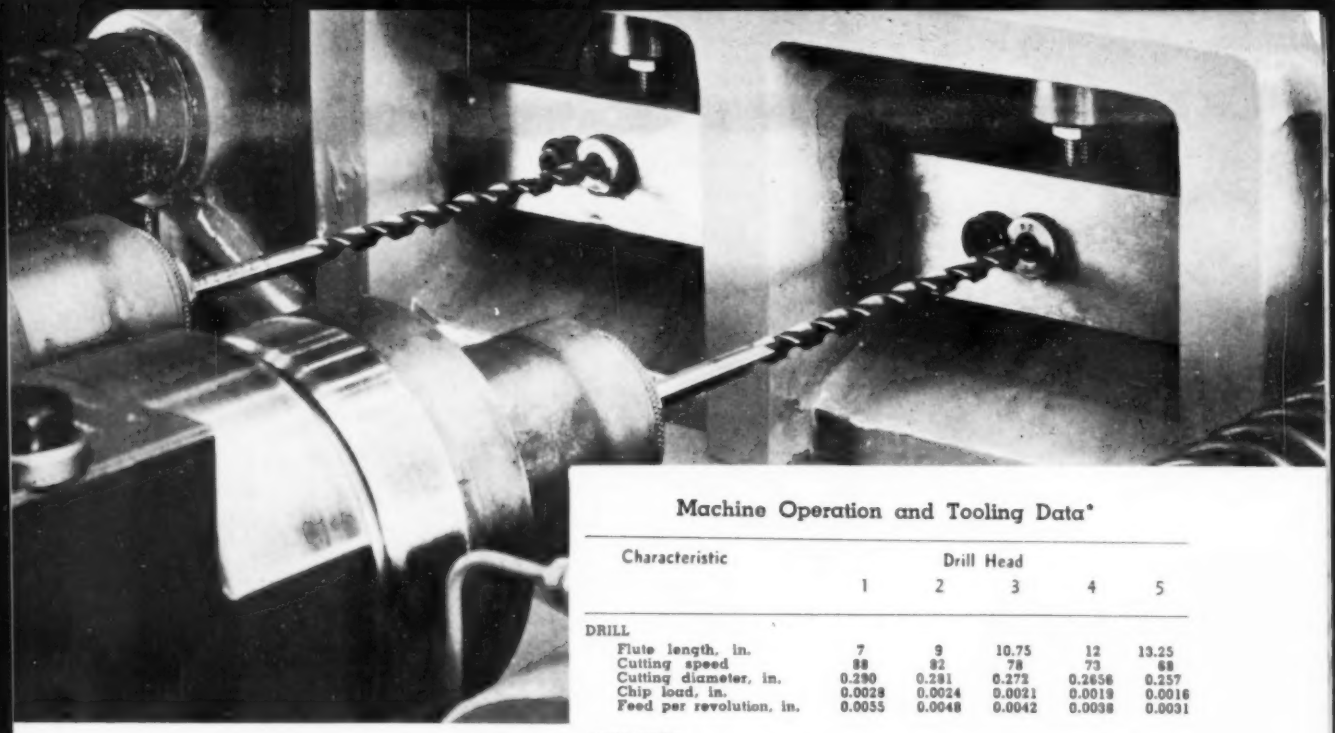


Fig. 2. Drills in Station 2 are the shortest but even these have a total cutting length of 9⅞ inches for a cutting diameter of 0.290 inch. Proximity pickup units are visible over the rear support bushings.

Machine Operation and Tooling Data*

Characteristic	Drill Head				
	1	2	3	4	5
DRILL					
Flute length, in.	7	9	10.75	12	13.25
Cutting speed	88	82	78	73	68
Cutting diameter, in.	0.290	0.281	0.272	0.2656	0.257
Chip load, in.	0.0028	0.0024	0.0021	0.0019	0.0016
Feed per revolution, in.	0.0055	0.0048	0.0042	0.0038	0.0031
DRILL HEAD					
Spindle speed, rpm	1158	1119	1088	1053	1007
Thrust per spindle, lb	290	246	230	210	186
Working stroke, in.	7	9	10.5	12	13
Feed stroke, in.	2.35	1.96	1.67	1.40	1.15
Feed rate, ipm	6.41	5.35	4.56	4.00	3.28
Power per head, hp	0.86	0.72	0.64	0.58	0.50
CYCLE TIME, SEC					
Rapid advance	2.5	2.5	2.5	3.0	3.0
Cutting time	22.0	22.0	22.0	21.0	21.0
Rapid return	2.5	2.5	2.5	3.0	3.0
Total head cycle time	27.0	27.0	27.0	27.0	27.0

*Two identical drills in each head.

because the required hole was over 7¾ inches deep and only about ¼ inch in diameter, this was deep-hole drilling. These conditions required several other decisions to be made by the tool engineer. Should the hole be drilled as one operation and, if so, how many withdrawals are necessary to prevent chip packing and consequent drill breakage?

The oil hole is not critical and several things could be done to reduce changes of a drill due to breakage. It was decided to drill the hole progressively in five steps, each step also being a little smaller in diameter than the preceding one. This would prevent rubbing and greatly extend the life of the drills. It would not be necessary to withdraw any of the drills during drilling because none of them would be going deep enough to cause chip-packing problems. Also, chip clearance would be larger than normal because of the enlarged diameters of the sections of the hole already drilled.

Machine Design: Output of the machine had to be about 250 parts per hour. With the known cutting and feeding conditions, it would be necessary to machine two parts at a time if the production requirements were to be met.

Configuration of the required machine was determined to have five hydraulically fed heads positioned around a dial index table. The table would have six positions for the five drilling stations and one load-unload station. Each of the heads would have two high-speed spindles, *Fig.* 2, carrying drills of equal diameter and length. Two workpieces would be clamped into each of the stations of the six-position holding fixture and would ride around the table.

Drilling Depth: Since the feed rates and cutting speeds were to be different, it was obvious that individual head cycling time could vary considerably. This would lead to inefficiency if the one station finished much earlier than another and remained idle before an index could be made.

The single most important cycle determining factor was the amount of depth to be added to the hole by each drill. If the drills did not extend the hole by the same amount, it would be possible to work out head-cycle times that would be equal. This was done and different amounts of time were assigned for rapid advance, feed and rapid return. Time used for three operations totals 27 seconds for each

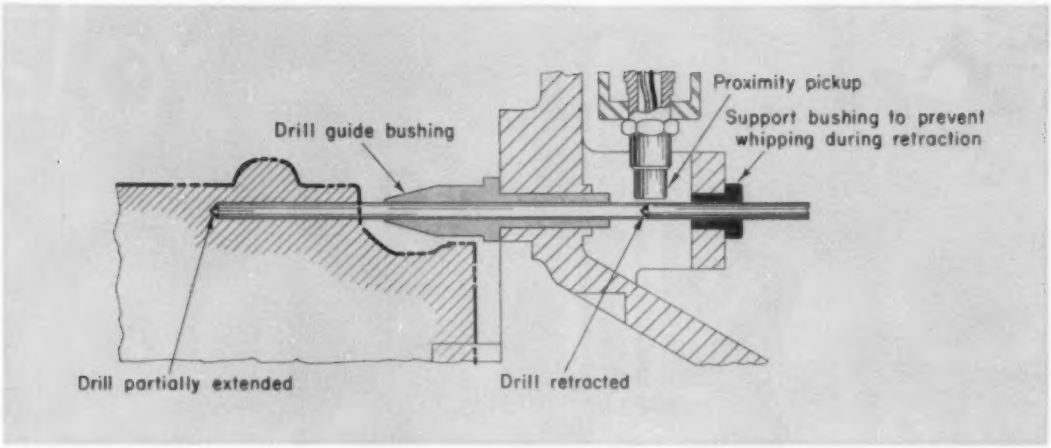


Fig. 3. Because the slender drills are also long, a rear support bushing is used in addition to the guide bushing. The proximity pickup is located over the retracted drill point and between the two bushings, so that it continuously monitors for broken drills.

head. In other words, all heads are ready for cycling at the same time and there is no wasted motion. As can be seen in the accompanying table, various machining characteristics follow normal trends as the drill size is reduced. As cutting diameter of the drills goes down, the feed per revolution, chip load, thrust, infeed rate and hole length added all reduce in value. Unfortunately, as the cutting diameter is reduced, the over-all length of the drill is increased. The smallest drill has an over-all length of 16 inches.

One other seemingly inconsistent condition can be noted in the table. The cutting speed also decreases as hole diameter decreases. This is contrary to standard drilling practice but leads to less breakage when such slender drills are used to such depths. Also, break-through of the drill during the last step does not introduce additional problems at the reduced speed.

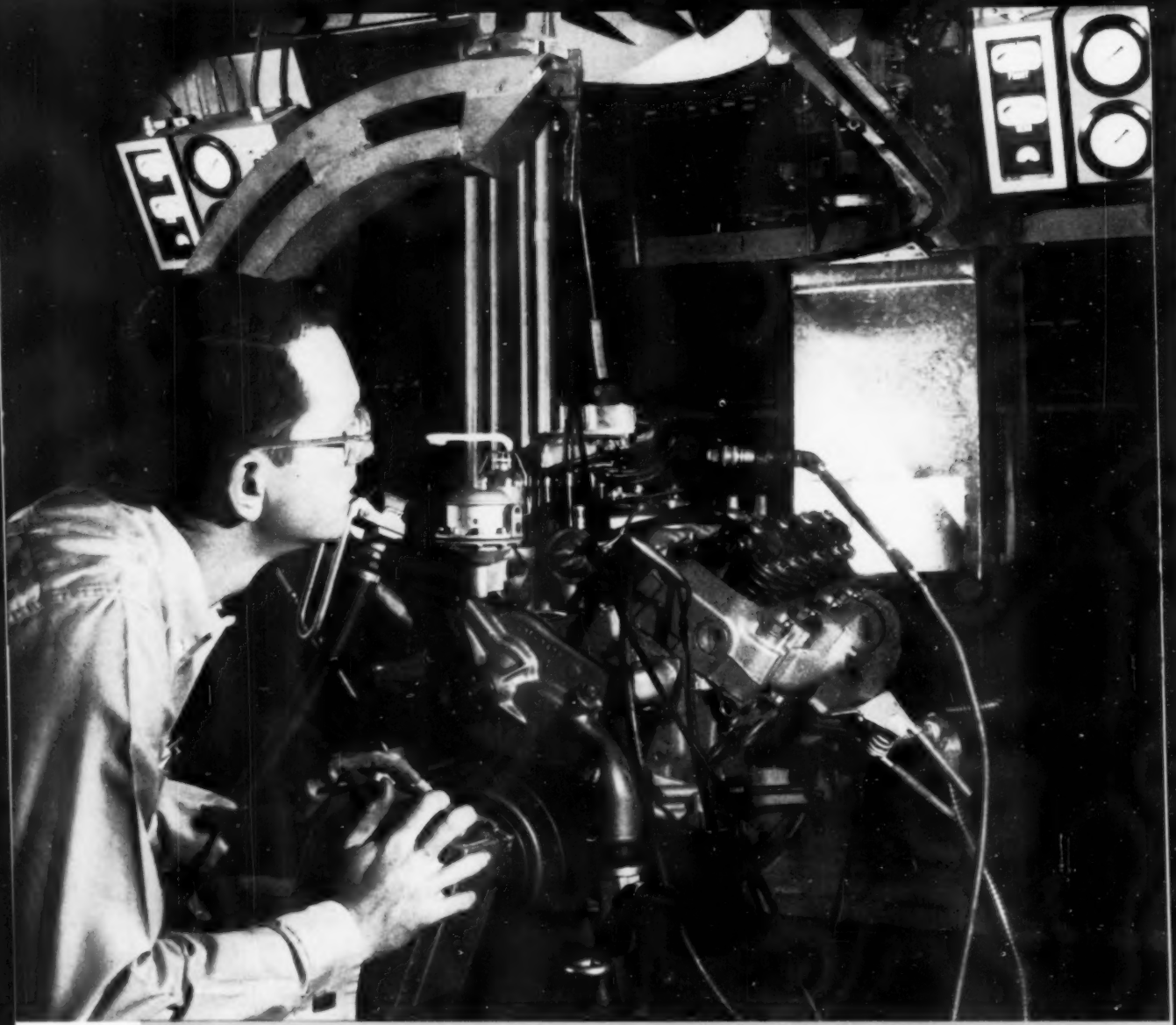
Proximity Switches: Deep-hole drilling with twist drills is not yet a routine operation. Since twist drills can be easily broken when the length-to-diameter ratio is over 60 to 1, an automatic machine, its tools and the workpieces have to be protected against the damaging conditions that could result from a broken drill. Mechanical probing of the hole after each step would satisfy the need but would take too much time from the cycle.

Standard, commercial proximity pickups (units that complete an electrical circuit in the presence of metal) are located over each drill, *Fig.* 3. The point of the drill is directly under the pickup when the drill is fully retracted and, in this position, the pickup can monitor the drill during the entire drilling stroke. Should the drill break and metal not be under the pickup at any time during the cycle, the open electrical circuit would introduce a signal into the control system. When amplified, the signal is used to stop the machine and light an identifying lamp on the operator's console. Resetting of the proximity-switch circuit is simply accomplished by replacing the broken drill with a new one. The control circuit is again completed through the metal of the drill and the machine can be returned to normal operation.

Whipping: Each of the long, slender drills is supported and guided by bushings during the drilling stroke. To prevent them from whipping and breaking during the period when retracted, another set of bushings is included, *Fig.* 3. These bushings are located behind the proximity pickup units and are always in contact with the drills.

Versatility: This machine is actually an engineered assembly of standard units. The same basic ideas behind its design can be used in many ways. For instance, the units of this machine are so engineered that they could do a similar job of using gun drills. In this case, only three of the heads would be used, but a high coolant pressure system would be required. Each gun drill would drill to full depth without stopping so the time cycle would be much longer.

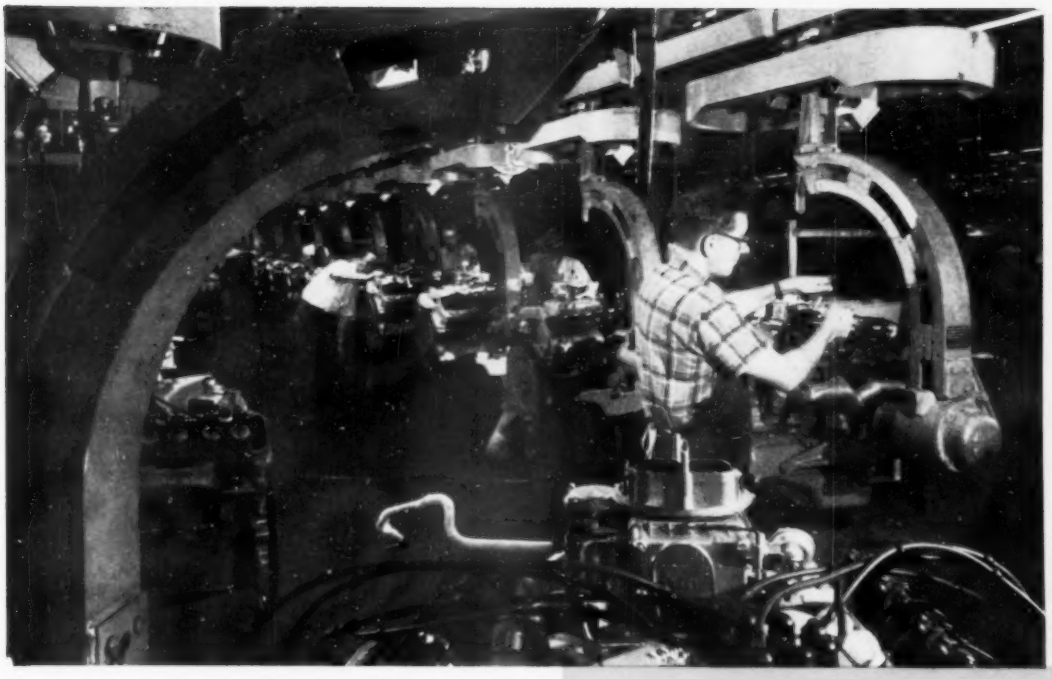
The three heads would be at three adjacent stations around the index table with the other three as loading stations. Thus, the table would be recycled to have only two positions. Six parts would be loaded in three workholding fixtures and the table indexed 180 degrees. All six parts would be drilled simultaneously while six more parts were being loaded in the other workholding-fixture positions.



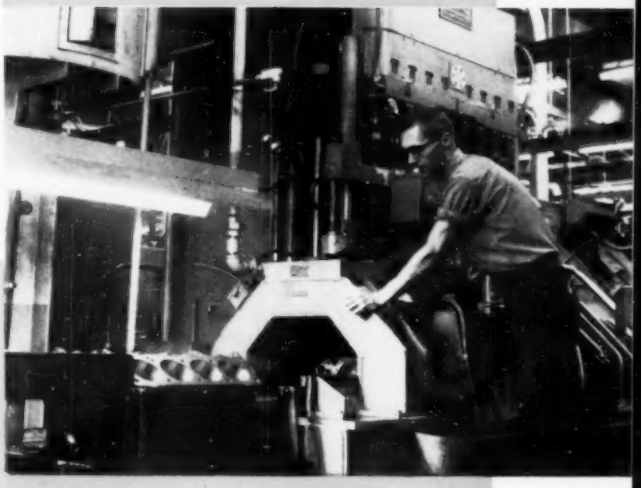
NEW TECHNIQUE of combining engine balancing with hot testing, developed by Ford Motor Co. for the Lima, Ohio engine plant, provides the advantage of dynamic balancing at speeds and operating conditions found in actual use. The electronic balancing unit indicates engine speed, location of unbalance, if any, and the weight to be added when necessary.

Engineered Engine Automation

At the new engine manufacturing plant in Lima, Ohio, Ford Motor Co. is taking another step toward the facility of the future—the automatic factory. The factory contains the latest machines and equipment. Among the interesting machines are cold extrusion presses for making piston pins, upright gun drilling operations for the cylinder heads and automatic crankshaft grinders. All the equipment was designed for peak performance with minimum maintenance.

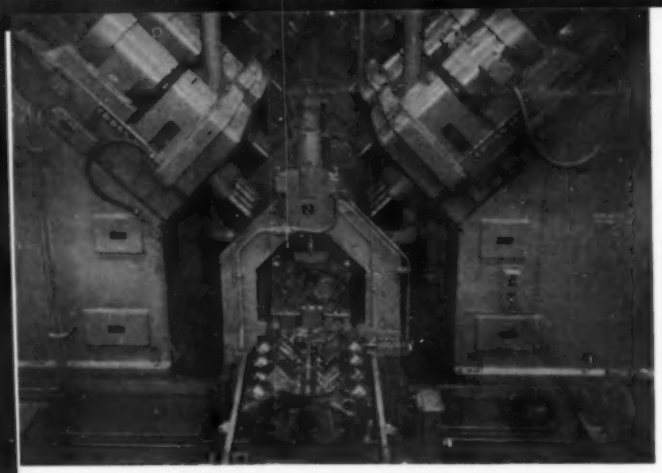


ENGINE ASSEMBLY OPERATIONS are facilitated with overhead steel arms, permitting the employees to move the heavy engines into the desired assembly position with a twist of the wrist. The engine block is attached to the carrier at the start of assembly operations and remains on the steel arms through assembly, test and repair operations.



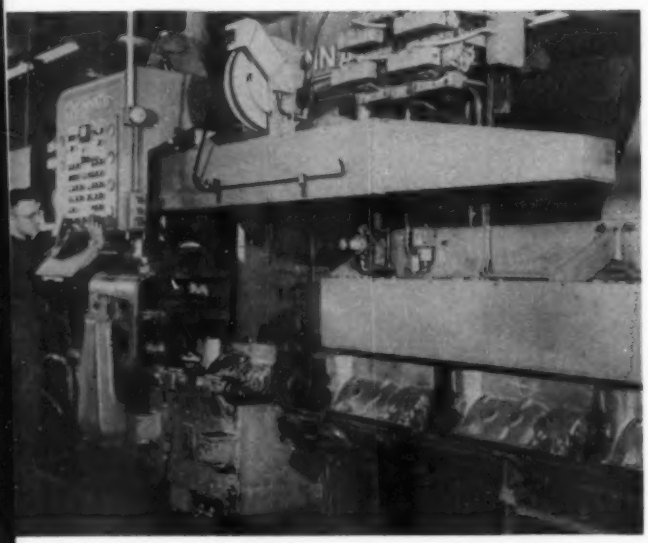
MICROMATIC HONING MACHINES give the engine cylinder bores the finished surfaces required for precision assembly. The eight-cylinder block is tilted to permit honing in a vertical position. The block is then transferred to the next station and tilted for honing the second bank of cylinder bores vertically.

TOOLS at work

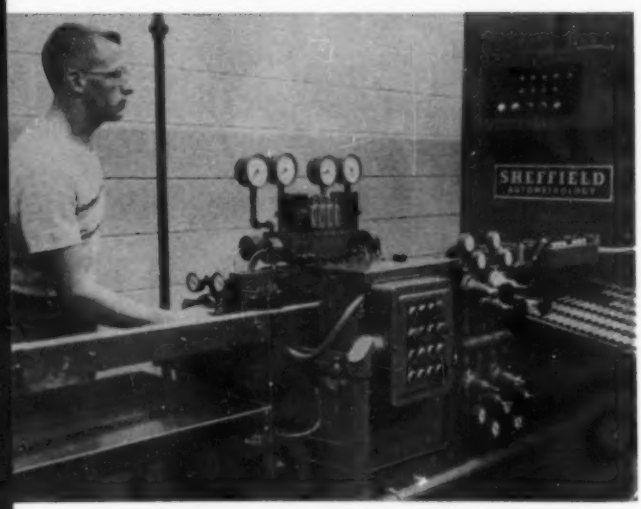


EACH BLOCK passes through 16 operations in this Cross transfer machine, which automatically drills and reams the tappet holes. Dust extracting tubes in the center remove the cast-iron dust from the machining area.

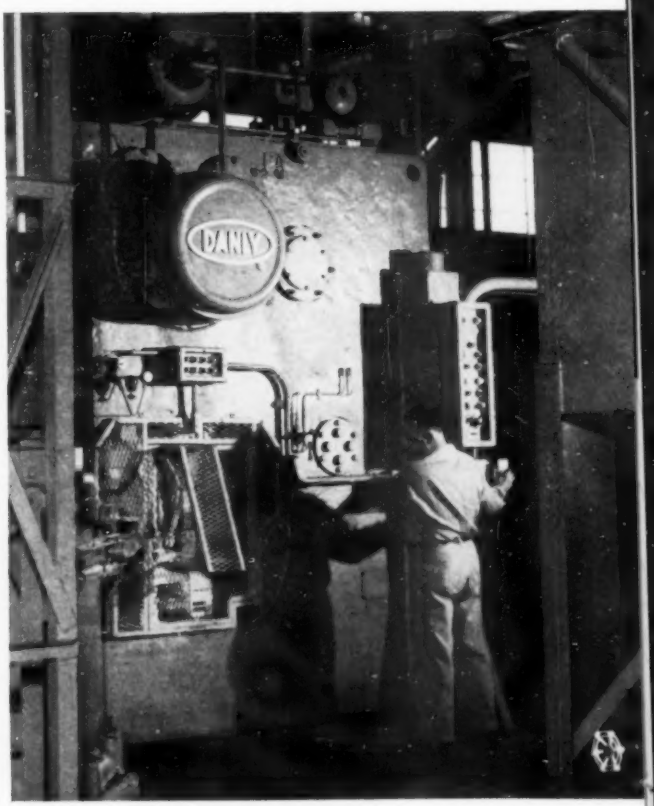
TOOLS at work



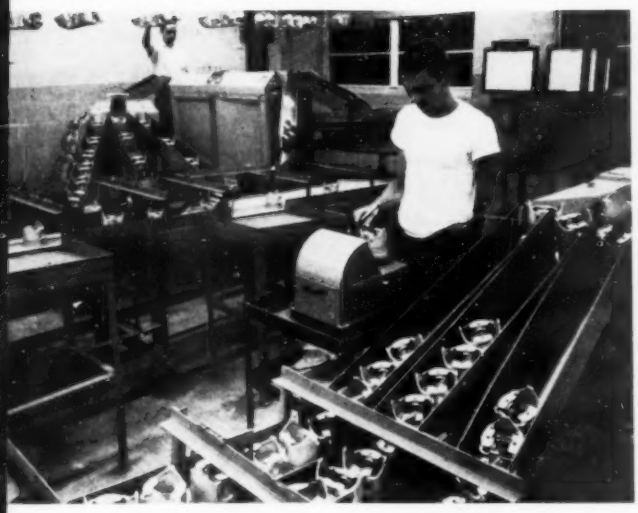
INITIAL MACHINING OPERATIONS on the engine block are performed by this Cincinnati surface broach. The block moves into the broach where it is automatically clamped to machine top and bottom. At the end of the operation, the workpiece is automatically unclamped and moved to the next machine.



SHEFFIELD ELECTRONIC INSPECTION and sorting machine checks automobile piston pins. They are fed into the testing device and are sorted into three classifications based on difference in size. Off-size parts are rejected.



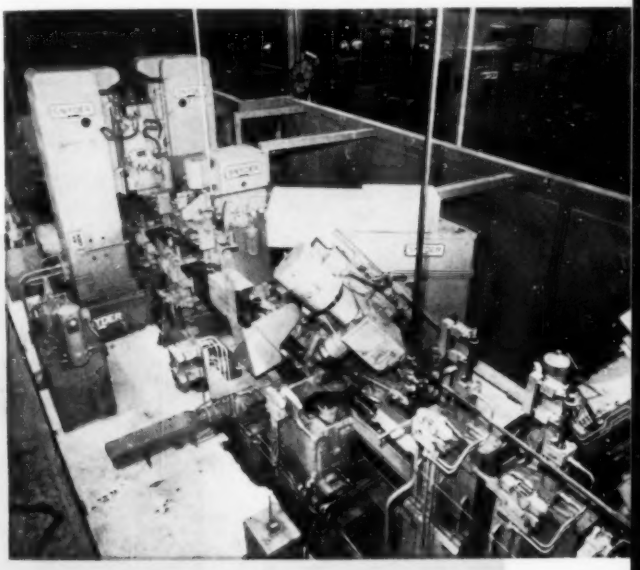
STEEL SLUGS are converted into piston pins in this Danly press. Cold extrusion of piston pins makes possible the production of 1900 pins per hour from one press. Slugs are conveyed from screw machines.



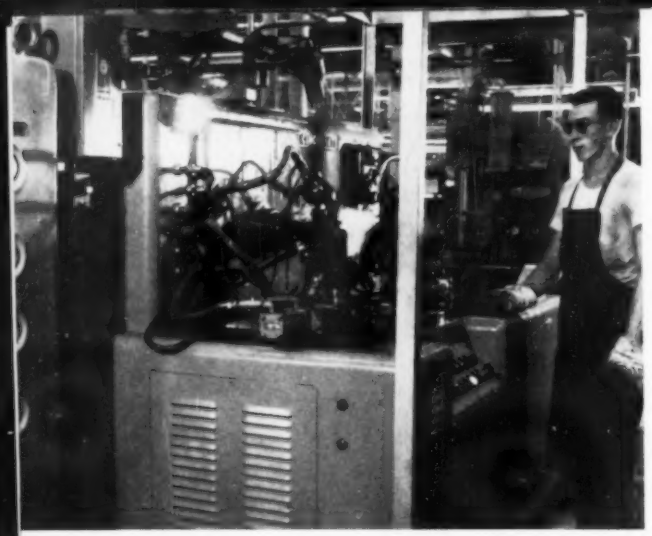
PISTONS FOR THE ENGINES are carefully sorted according to differences in weight and size before passing to assembly areas. Exact sizing of the pistons enable the assemblers to selective fit the the engine components.

SEVEN different drilling, milling and reaming operations are performed on the engine pistons as they are transferred through this special machine. Capable of machining 600 pistons hourly, this transfer type machine, built by Motch & Merryweather, is one of many automatic machines in the department.

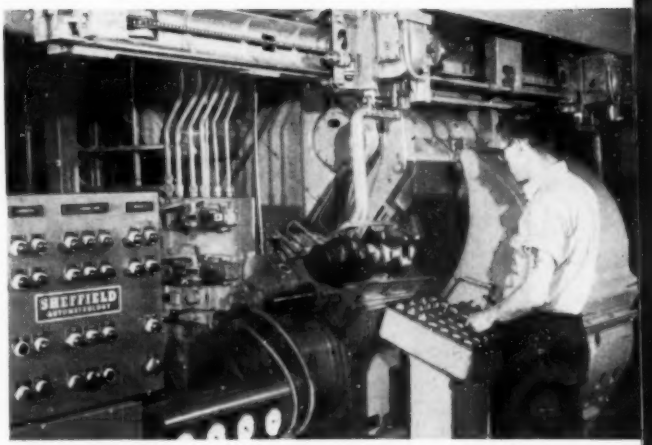
MICROMATIC HONING MACHINE permits precision machining of the crank end of the connecting rod. Four machines are used for honing the crank end of the rod and four for pin end honing. Each machine holds four connecting rods and produces about 450 rods per hour.



DRILLING, milling and tapping operations are performed on an exhaust manifold as it passes through the 28 stations of this Snyder machining line. Castings are transferred and machined through the line without pallets.

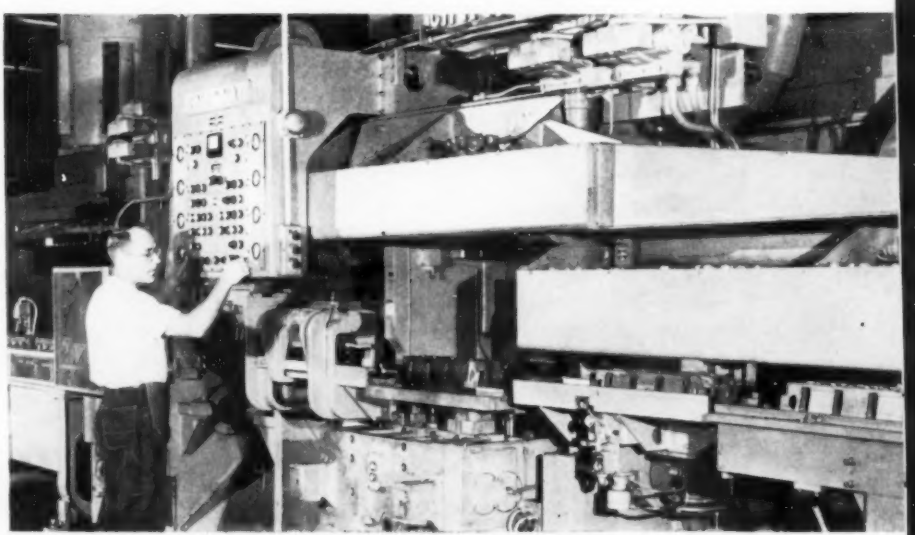


FLAMATIC OPERATION hardens the gear on an engine camshaft sprocket. As the gear revolves, the flame jets heat the teeth to the proper hardening temperature. Then, the part is automatically ejected into an oil bath where it is quenched and hardened.



QUALITY CONTROL GAGES keep a close check on crankshafts during the machining processes. This automatic LeBlond lathe for machining and rough turning of the bearings on the crankshaft is controlled by the Sheffield gage which determines when the part is correctly machined. Any variation in the machining process is indicated on the gage and tooling corrections are made before production resumes. Similar forms of in-process quality control play an important part in engine production.

FINAL GRINDING OPERATIONS on crankshafts are performed on this automatic machine to obtain the finished surfaces necessary for proper functioning of an engine.



AN ENGINE cylinder head begins its journey down a long machining line at this initial broaching operation. Other equipment along this line features extensive use of automation equipment highlighted by gun drilling and reaming operations.

determining STOCK SIZES ...for optimum machining and inventory costs

By Edward C. Varnum*
Head, Operations Research
Barber-Colman Co.
Rockford, Ill.

When workpieces of various sizes are required in quantity, it is desirable that the stock be as close to finished size as possible. At the same time, carrying large inventories of different stock sizes can be costly. A mathematical approach, developed by the author, gives optimum stock sizes and quantities.

STOCKING THE PROPER QUANTITIES and sizes of raw material can often mean the difference between profit and loss when machining large numbers of parts having various diameters and lengths. An example is bar stock which, in a typical case, may be required in lengths from 16 to 22 feet, with intermediate lengths required in varying amounts. It is desirable that the number of stock lengths kept in inventory be at a minimum. At the same time, if only a few sizes are kept in stock, considerable stock will be wasted in cutoff operations.

Determining the optimum quantities and sizes of stock for lowest over-all costs can be accomplished mathematically. In making these calculations, it is assumed that quantity and size requirements fall into a regular pattern with the greatest demand for the average lengths and the least demand for the largest and smallest lengths. In terms of probability theory, the pattern is known as a demand distribution which, in this case, has high probabilities around the region of average length and low probabilities at the extremes of the size range.

Such distributions have been studied by the mathematician Carl Friedrich Gauss, who derived an equation that gives the probability of obtaining a given size x when the average $\bar{x}$ and the theoretical spread of the pattern σ are known. This pattern is observed so often in nature that it is called the normal distribution or, in honor of its discoverer, the Gaussian distribution. The equation for the normal distribution is:

$$f(x) = \frac{1}{\sigma\sqrt{2\pi}}\, e^{\frac{-(x-\bar{x})^2}{2\sigma^2}} \qquad \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

where $f(x)$ is the probability that size x will be demanded, $\bar{x}$ is the average x, σ is the standard deviation (a measure of the theoretical spread) and π and e are mathematical constants.

The normal distribution shown in Equation 2 underlies many statistical concepts. Most control charts for industrial inspection are based on the central limit theorem, which says that a normal distribution arises whenenver averages of samples are tabulated. Educators use the normal distribu-

*Senior member ASTE Rockford chapter.

tion for grading students. Precision testing laboratories apply the same distribution to the study and control of observational errors.

Assuming a normally distributed demand in the bar stock problem, it can also be assumed that only a few sizes are to be stocked. A numerical solution for three stocked sizes was worked out by F. Hanssmann*. By stocking 48 bars 18.94 feet long, 39 bars 20.14 feet long and 13 bars 22.00 feet long for every 100 bars required, the loss of material cut off will be less than for any other three sizes.

Stocking various bar diameters rather than bar lengths is another common problem. Such problems arise when stocking blanks for helical gears having a given face width or in stocking forged hob blanks of fixed height but variable diameters. In order to answer this kind of question, the Hanssmann procedure has been generalized.

In working out a solution, it is assumed that the parts being stocked are cylindrical and of fixed height, but that the diameters required are distributed according to Equation 1. Further, it is assumed that only n sizes are to be stocked. Consequently, if a required diameter is not in stock the next larger stock size is selected. Material is removed until the required diameter is obtained.

*See "Determination of Optimal Capacities of Service for Facilities with a Linear Measure of Inefficiency," *Operations Research*, Oct., 1957.

The problem, then, is to determine the exact diameters to be stocked so that the amount of material removed in bringing parts to finished size is as small as possible.

To solve the problem, a loss function is set up for a given diameter x:

$$L(x) = \pi k h (x_s^2 - x^2) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

The symbol k represents a constant related to the density and cost per pound of the material; h is the constant height of all cylinders; x is the diameter of a required cylinder and x_s is the diameter of a stocked cylinder that is just larger than the required cylinder. $L(x)$ represents the volume lost due to reducing a cylinder of diameter x_s to a cylinder of diameter x, multiplied by k, the cost per unit volume. Thus $L(x)$ measures the dollar cost of material scrapped when a diameter of x units is requisitioned from stock.

When $L(x)$ is the loss associated with a required diameter of size x, and $f(x)$ is the probability of size x being demanded, total loss, T, can be calculated by integrating $L(x) \cdot f(x)$ over the full range of sizes. It is assumed that the minimum size is zero and, as in many other statistical applications, that the maximum required diameter is three standard deviations greater than the average. The maximum required diameter is designated b. The largest stocked diameter will also equal b. In other words, $x_n = b$.

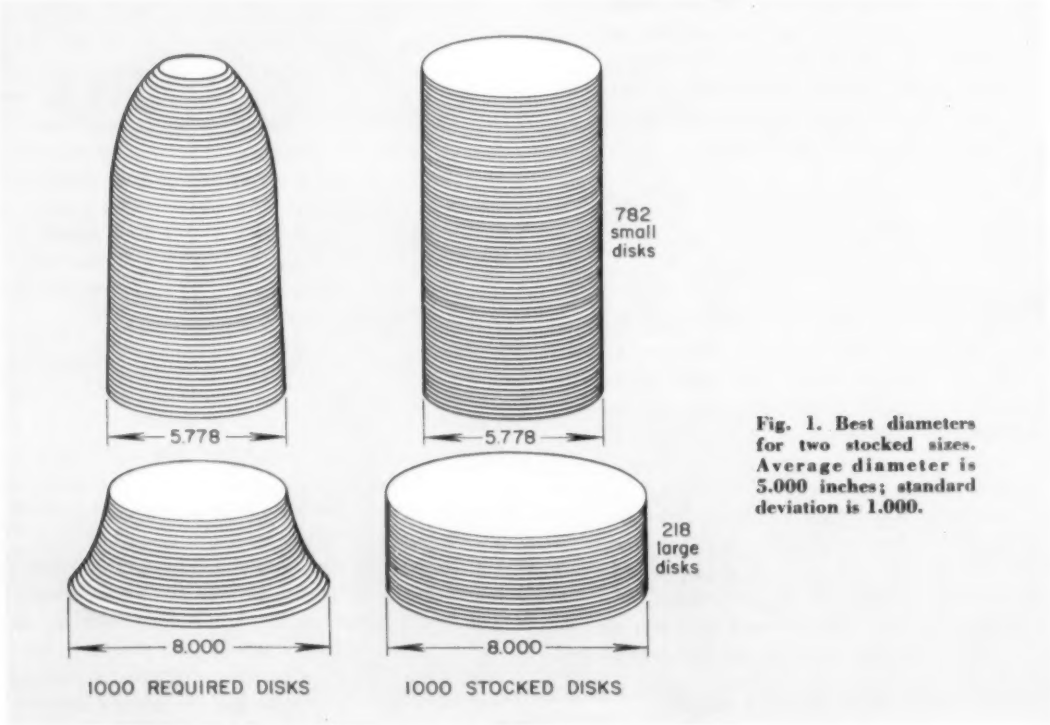


Fig. 1. Best diameters for two stocked sizes. Average diameter is 5.000 inches; standard deviation is 1.000.

$$T = \int_0^b L(x)\, f(x)dx$$

$$= \int_0^{x_1} \pi kh\, x_1^2\, f(x)dx + \int_{x_1}^{x_2} \pi kh\, x_2^2\, f(x)dx + \cdots\cdots$$

$$= \int_0^{x_1} \pi kh\, x^2\, f(x)dx - \int_{x_1} \pi kh\, x^2\, f(x)dx \cdots\cdots - \int_{x_{n-1}}^{x_n} \pi kh\, x^2\, f(x)dx$$

$$= \pi kh\left[x_1^2\int_0^{x_1} f(x)dx + x_2^2\int_{x_1}^{x_2} f(x)dx + \cdots\cdots \cdots\cdots + x_n^2\int_{x_{n-1}}^{b} f(x)dx - \int_0^b x^2\, f(x)dx\right]$$

For any choice of $x_1; x_2; x_3; \ldots; x_n$ the value of $\int_0^b x^2\, f(x)dx$ will be unchanged so that it does not need to be considered. Also, $\pi\, kh$ is constant and will not alter the choice of $x_1; x_2; x_3 \ldots; x_n$ which makes T minimum. Thus only a function V, defined as follows, need be considered.

$$V = x_1^2\int_0^{x_1} f(x)dx + x_2^2\int_{x_1}^{x_2} f(x)dx + \cdots + x_n^2\int_{x_{n-1}}^{b} f(x)dx \quad \cdots\cdots\cdots\cdots (3)$$

Using cumulative distribution functions, each of the integrals, evaluated at their limit points, can be expressed as the difference of the indefinite integral:

$$\int_{x_{i-1}}^{x_i} f(x)dx = F(x_i) - F(x_{i-1});\ i = 1, 2, \ldots, n$$

The V function can be written in the form:

$$V = x_1^2 F(x_1) - x_1^2 F(o) + x_2^2 F(x_2) - x_2^2 F(x_1) + \cdots\cdots + x_n^2 F(x_n) - x_n^2 F(x_{n-1}) \quad \cdots\cdots\cdots\cdots (4)$$

In order to minimize V with respect to the n variables, $x_1; x_2; x_3; \ldots; x_n$ partial derivatives with respect to each of the variables are taken:

$$\frac{\delta V}{\delta x_1} = x_1^2 f(x_1) + 2x_1 F(x_1) - 2x_1 F(o) - x_2^2 f(x_1) \quad \cdots\cdots\cdots\cdots (5)$$

$$\frac{\delta V}{\delta x_2} = x_2^2 f(x_2) + 2x_2 F(x_2) - 2x_2 F(x_1) - x_2^2 f(x_2) \quad \cdots\cdots\cdots\cdots (6)$$

$$\frac{\delta V}{\delta x_i} = x_i^2 f(x_i) + 2x_i F(x_i) - 2x_i F(x_{i-1}) - x_{i+1}^2 f(x_i)$$

Setting the right-hand side of Equation 5 equal to zero, one can solve for x_2. Equation 6 will yield a solution for x_3 when the right member is set equal to zero. In general terms, the value of x_i can be expressed:

$$x_i = \sqrt{x_{i-1}\left\{x_{i-1} + \frac{2\,[F(x_{i-1}) - F(x_{i-2})]}{f(x_{i-1})}\right\}}$$

$$; i = 2, 3, \ldots, n$$

The set of $n-1$ equations can be solved by numerical iteration for specific values of n. This numerical solution consists of estimating x_1 and calculating all of the other x_i's, using the equations in order. If the calculated value of x_n is less than b, a slightly higher value for x_1 is tried and the calculations are repeated. For a third trial, interpolation can be used to find a better estimate for x_1. The process is continued until x_n is satisfactorily close to b, say, within 0.0002.

Table 1—Best Two Stock Diameters*

Average Diameter	Smaller Diameter Size	Smaller Diameter Pieces per Thousand	Larger Diameter Size	Larger Diameter Pieces per Thousand
3.000	3.824	795	6.000	205
4.000	4.797	787	7.000	213
5.000	5.778	782	8.000	218
6.000	6.763	777	9.000	223
10.000	10.730	767	13.000	233
20.000	20.700	758	23.000	242
25.000	25.693	756	28.000	244
100.000	100.672	749	103.000	251
1000.000	1000.666	747	1003.000	253

*For normally distributed demand having unit standard deviation

As a specific numerical example, the simplest case, that is, stocking only two sizes, one of which is the maximum required diameter, can be considered. The average diameter is assumed to be 10.0000 inches and the maximum to be 13.0000 inches. In statistical language this is essentially equivalent to a mean of 10 and a standard deviation of 1. To solve this problem, only the first equation for x_i is needed. Assuming a value of 10.7000 for x_1, and substituting into the equation:

$$x_2 = \sqrt{10.7000\left[10.7000 + \frac{2(0.7580 - 0)}{0.31226}\right]}$$

$$= \sqrt{166.4377350}$$

$$= 12.9011$$

Table 2—Best Three Stock Diameters*

Average Diameter	Smallest Diameter Size	Smallest Diameter Pieces per Thousand	Intermediate Diameter Size	Intermediate Diameter Pieces per Thousand	Largest Diameter Size	Largest Diameter Pieces per Thousand
3.000	3.125	550	4.295	352	6.000	98
4.000	4.088	535	5.266	362	7.000	103
5.000	5.063	525	6.245	368	8.000	107
6.000	6.045	518	7.230	372	9.000	110
10.000	10.006	502	11.194	382	13.000	116
20.000	19.973	489	21.163	389	23.000	122
25.000	24.966	487	26.158	390	28.000	123
100.000	99.942	478	101.132	395	103.000	127
1000.000	999.936	475	1001.128	396	1003.000	129

*For normally distributed demand having unit standard deviation.

In these equations, 0.7580 is $F(10.7000)$, that is, the area under a Gaussian curve from negative infinity to 0.7 standard deviations greater than the mean. The number 0.31226 is $f(10.7)$ or the probability of occurrence of a value 0.7 standard deviations above the mean, as found in a table of ordinates for a normal curve.

Because 12.9011 is less than 13.0000, the estimate of x_1 is increased from 10.7000 to 10.7500, with the following result for x_2:

$$x_2 = \sqrt{10.7500\left[10.7500 + \frac{2(0.7734 - 0)}{0.30114}\right]}$$

$$= \sqrt{170.7796740}$$

$$= 13.0683$$

For the third estimate for x_1, one can interpolate, as follows:

$$x_1 = \frac{(0.0683)\ (10.7000) + (0.0989)\ (10.7500)}{0.0683 + 0.0989}$$

$$= 10.7296$$

Using this estimate:

$$x_2 = \sqrt{10.7296\left[10.7296 + \frac{2(0.7673)}{0.30566}\right]}$$

$$= 12.9991$$

If greater accuracy is desired, one can interpolate again to find a value of 10.7299 for x_1 and a value of 13.0001 for x_2. Working to the nearest 0.0001 inch, stock diameters of 10.7299 inches and 13.0000 inches will give the least loss of material for a normally distributed demand with an average of 10 inches and a maximum of 13 inches.

When two diameters are stocked, a fixed unit standard deviation is used to find x_1 for values of x. Several cases have been calculated as shown in TABLE 1.

In order to visualize the significance of TABLE 1, it is assumed that the cylinders are thin disks and that there are exactly one thousand required. In most applications, of course, the cylinders are not thin, but the height of the cylinders does not affect the problem as long as all heights for a given problem are the same. If one thousand normally distributed disks were stacked in an orderly fashion with the largest disk at the bottom there would be a pile as shown in the left side of *Fig.* 1. In a typical case, it might be advantageous to stock only two sizes, both selected so that the material removed would be a minimum. In the example a mean diameter of 5.000 and a standard deviation of 1.000 have been assumed so the third entry of TABLE 1 can be used to find the answer. Consulting the table, it is seen that 782 small cylinders (diameter 5.778) and 218 large cylinders (diameter 8.000) should be stocked, as shown on the right side of *Fig.* 1. The stack of required disks has also been separated into two parts to show the correspondence between stock and requirements.

Using TABLE 1, certain other problems can be solved directly if the average diameter is an exact multiple of the standard deviation and if the ratio is numerically equal to a number in the first column of TABLE 1. For example, for a distribution whose average is 60 units and whose standard deviation is 3 units, 20.700 can be multiplied by 3 to obtain a smaller stock diameter of 62.100 units. Obviously, the larger stock diameter of such a distribution will be 69.000 units, according to the assumption that the average plus three standard deviations is the maximum diameter of the distribution. This truncation of the upper tail of the distribution introduces an error which could be compensated for in the evaluation of the $F(x_i)$ values, but the practical circumstances of the problem do not merit such adjustment.

If three cylinder sizes are to be stocked, the following equations for x_2 and x_3 are used after estimating x_1:

$$x_2 = \sqrt{x_1\left[x_1 + \frac{2\,F(x_1)}{f(x_1)}\right]}$$

$$x_3 = \sqrt{x_2\left\{x_2 + \frac{2\,[F(x_2) - F(x_1)]}{f\,(x_2)}\right\}}$$

As a numerical example of the iterative calculations, an average of 5 inches and a standard devia-

tion of 1 inch are assumed. To begin, an x_1 value of 5.05 is estimated and x_2 and x_3 are calculated.

$$x_2 = \sqrt{5.05\left[5.05 + \frac{2(0.5199)}{0.39845}\right]}$$

$$= \sqrt{38.68104161}$$

$$= 6.2194$$

$$x_3 = \sqrt{6.2194\left[6.2194 + \frac{2(0.8887 - 0.5199)}{0.18968}\right]}$$

$$= 7.9288$$

Because 7.9288 is slightly less than the assumed maximum of 8 inches, the estimate of x_1 is increased to 5.07. Recalculating:

$$x_2 = \sqrt{5.07\left[5.07 + \frac{2(0.5279)}{0.39797}\right]}$$

$$= \sqrt{39.15542596}$$

$$= 6.2574$$

$$x_3 = \sqrt{6.2574\left[6.2574 + \frac{2(0.8957 - 0.5279)}{0.18096}\right]}$$

$$= 8.0369$$

Interpolating to find a third estimate of x_1:

$$x_1 = \frac{(0.0369)(5.05) + (8 - 7.9288)(5.07)}{0.0369 + (8 - 7.9288)}$$

$$= 5.0632$$

Using 5.0632 inches as the smallest stocked diameter, the intermediate and largest diameters are calculated:

$$x_2 = \sqrt{5.0632\left[5.0362 + \frac{2(0.5252)}{0.39815}\right]}$$

$$= 6.2445$$

$$x_3 = \sqrt{6.2445\left[6.2445 + \frac{2(0.8934 - 0.5252)}{0.18391}\right]}$$

$$= 7.9998$$

This accuracy of agreement between the calculated and theoretical value of x_3 is sufficient for

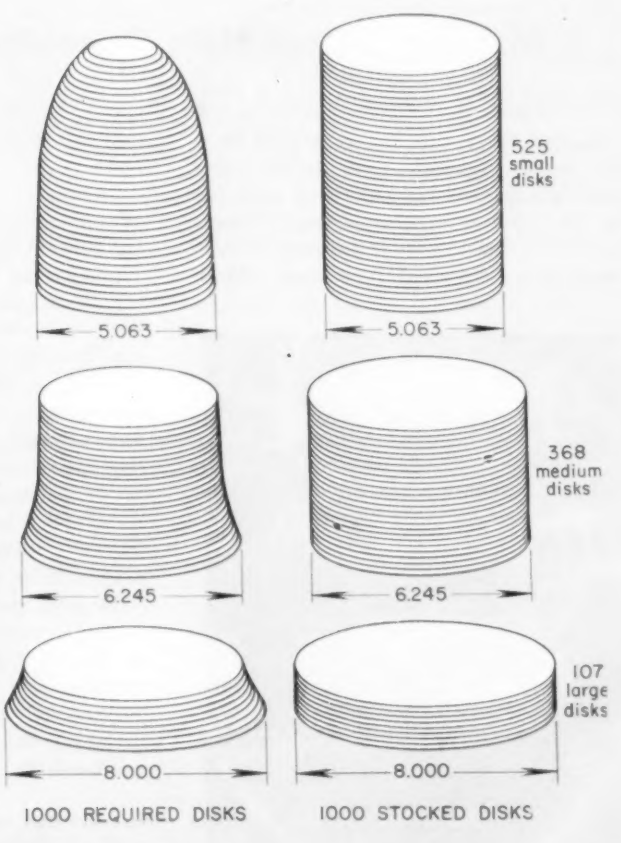


Fig. 2. Best diameters for three stocked sizes. Average diameter is 5.000 inches; standard deviation is 1.000.

practical purposes, so it can be stated that if three stock sizes are required for constant-height cylinders having normally distributed diameters averaging 5 inches and maximum diameters of 8 inches, the best diameters to stock are 5.0632 inches, 6.2445 inches and 8.0000 inches.

TABLE 2 contains this result, along with other values of the average diameter. As with TABLE 1, TABLE 2 assumes that the standard deviation is 1.

To illustrate the third entry of TABLE 2 pictorially, a requirement of one thousand thin disks normally distributed with a mean of 5.000 and a standard deviation of 1.000 is assumed, with the further assumption that three different diameters are to be stocked. The required disks are separated into three groups as shown in *Fig.* 2 and the respective stock from which they come is shown, namely, 525 disks of 5.063-inch diameter, 368 disks of 6.245-inch diameter and 107 disks of 8.000-inch diameter.

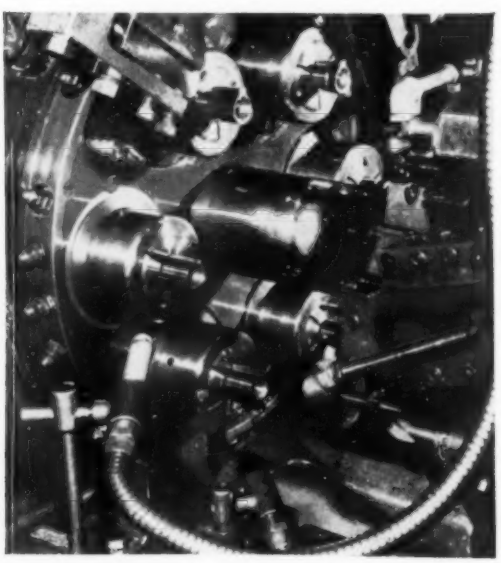
TABLE 2 can be used without interpolation if the ratio of the average diameter divided by the standard deviation is exactly equal to 3, 4, 5, 6, 10, 20, 25, 100 or 1000. For example, with an average diameter of 80 units and a standard deviation of 4 units, a ratio of 20 is calculated, so the values 19.973, 21.163 and 23.000 are each multiplied by four to obtain the three stock diameters.

Four stock diameters can be chosen for a given average and standard deviation by the repeated use of the first three x_i equations, until the calculated value of x_4 equals the maximum diameter of the distribution. Any specified number of stock diameters can be used, along with the use of a sufficient number of the x_i equations, to find the best stock diameters.

Although calculations for two and three stocked diameters were on the Gaussian distribution, the distribution function $f(x)$ and its cumulative function $F(x)$ can be given a reasonable non-Gaussian mathematical form, or may be determined empirically from a study of the demand itself. Use of differential calculus in finding the minimum of the V function also implies continuity of the demand function, which is often discrete in actual warehousing situations. Because of these considerations, theoretical results expressed here should serve as rough guides.

Material Switch Nets Operating Economy

PROCESS SIMPLIFICATION with consequent time and cost saving grew out of a change in material for a large-scale production part. Hot-extruded cold-drawn steel bars replace standard round stock for clamping rings in fuel injection pumps. Result: machining time reduced about 22 percent, and cost saving lessened an estimated 18 percent. Prime reason for the economy was elimination of two milling operations and one grinding operation on blank rings.



Six steel bars shaped by J & L hot extrusion equipment are machined into blank rings on a Gridley automatic screw machine.

This sample of the possible advantage of re-evaluating operations grows out of the look which American Bosch Arma Corp. took at its work in search of a simpler way to make rings.

Engineers working with Jones & Laughlin Steel Corp. evolved a simple solution. Die shaped extruded steel bars 10 to 12 feet long, provide dimensional tolerances so close that there is no need for external machining beyond cutting teeth in the rings. The necessary contour formerly had to be milled out of ring blanks cut from round bars. In the manufacturing operation, blanks $\frac{3}{8}$ inch wide are cut from the extruded bars on an automatic screw machine that performs the same six initial machining operations as done previously on the round steel bars. Subsequent operations put 15 gear teeth in the 158-degree segment and provide means of clamping the ring on a sleeve in the fuel injection pump. A lockscrew hole is drilled through the projection on the ring and tapped on one side. The ring is then cut by a milled slot through the center, and work is completed.

grinding SPACE AGE MATERIALS

By John A. Mueller
Manager, Grinding Laboratory
Carborundum Co.
Niagara Falls, N. Y.

MATERIALS USED for high-temperature or high-strength applications have physical properties which magnify manufacturing problems. Since most of these materials are hard, grinding is used to produce close tolerances, fine finishes and accurate forms. In some cases such as hard nonmetallic materials, grinding is the only means of altering dimensions or producing required finishes.

Dense Silicon Carbide: For most efficient grinding a double operation is best. To remove stock and hold dimensions, a diamond wheel is required. A luster and smooth finish can be produced with a silicon carbide wheel. The silicon carbide wheel cannot be depended on to remove stock to any appreciable degree and it will not alter dimensions produced by the diamond wheel. Recommendations for grinding dense silicon carbon are shown in TABLE 1. These values are a starting point and form a good basis for getting an operation underway.

Finish grinds can be obtained by using a finer grit than indicated in the table, such as 220 or 440 grit. The finish, however, is dependent on the porosity of the material.

Alumina: Material such as high purity dense alumina can be ground with both diamond and nondiamond abrasives. Finishes for roughing are in the neighborhood of 20 microinches and for fin-

Abstracted from Paper 138, "Grinding Techniques for Advance Materials," presented at the ASTE Semi-annual Meeting. Copies of the complete paper are available for purchase from Society Headquarters.

Table 1—Grinding Specifications for Dense Silicon Carbide

Specification	Centerless		Surface	
	Roughing	Finish	Roughing	Finish
Wheel speed (fpm)	5500-6500	5500-6500	6000	6000
Work speed (fpm)	84	202		
Table speed (fpm)	----	----	35-50	50
Crossfeed (in.)	----	----	0.030	0.010-0.030
Grinding fluid	Water soluble	Water soluble	Water soluble	Water soluble
Wheel abrasive	Diamond	Silicon carbide	Diamond	Silicon carbide
Wheel grit size	100	80	100	100-120
Wheel grade	N	J-K	N	J-K
Wheel bond	Metal	Vitrified	Metal	Vitrified
Dressing	None	Medium	None	Medium
Infeed per pass (in.)	0.0005-0.001	0.0002—No appreciable stock removal	0.001	0.0002—No appreciable stock removal
Finish (microinches, rms)	35-40	6-7	16	6
Tolerances	Size and taper 0.0001 in.	Size and taper 0.0001 in.	Size and taper 0.0001 in.	Size and taper 0.0001 in.

ish work in the range of two to five microinches.

When grinding this material care should be exercised so that the grinding wheel does not produce an impact on the workpiece. A shock may crack the material and workpieces should be ground as close as possible to the center of a chuck.

Sprayed Coatings: Thermo-spray coatings are of three classes: flame-sprayed alumina, phenolic-impregnated flame-sprayed alumina, and chromium-nickel-boron selfl-fluxing alloys. For roughing 100 grit resinoid bond diamond wheels have been used successfully. Resinoid is used to minimize heat and pressure. These coated materials may shell off the parent roll if excessive heat and pressure are produced. A resinoid diamond wheel will remove stock rapidly and maintain accurate size control. Finish is in the vicinity of 50 microinches.

For finishing, silicon carbon vitrified wheels generate a high luster. They remove practically no stock. Logical starting specifications are 46 to 60 grit in J grade vitrified bond.

Zirconium: Zirconium is finding much use in the nuclear energy field. Tests have shown that it is much easier to grind than titanium, but much harder than low-carbin steel. A comparison of the grindability of zirconium relative to other metals is shown in TABLE 2.

Generally grinding techniques for zirconium are similar to those for titanium. Silicon carbide wheels have been found superior to aluminum oxide for surface grinding. Aluminum oxide is satisfactory for cylindrical grinding and snagging. Operations and wheel recommendations are summarized in TABLE 3.

Molybdenum: Another material coming into use is high purity molybdenum. This material is easy to grind at conventional feeds and speeds and with conventional machinery. Aluminum oxide is superior to silicon carbide for grinding. A water miscible grinding fluid should be used. TABLE 4 shows speeds and feeds that have been used successfully with molybdenum.

Table 2—Grindability of Zirconium

Material	Grinding Ratio
Titanium	0.7 Hardest to grind
Zirconium	1.2
High Vanadium alloy steel	1.3
Medium alloy steel	15.0
Low carbon steel	50.0 Easiest to grind

Table 3—Wheel Selection for Zirconium

Grinding Operation	Grain Type	Bond Type	Grit Size	Wheel Grade
Surface	Silicon carbide	Vitrified	46-60	J
Cylindrical	Aluminum oxide	Vitrified	60-80	L-M
Snagging	Silicon carbide	Resinoid	20	P
Cutoff	Silicon carbide	Rubber	60	L

Table 4—Grinding Specifications for High Purity Molybdenum

Operation	Wheel Speed (fpm)	Infeed (in. per pass)	Type of Grind	Work Speed (fpm)	Table Speed (fpm)	Cross Feed (inches)	Finish (microinches, rms)	Grit	Grade
Surface	5500-6500	0.002	Wet or Dry	—	50	0.032	11	40-60	J-K
Surface	5500-6500	0.005	Wet	—	50	0.032	18-23	40-60	J-K
Cylindrical	5500-6500	0.001	Wet or Dry	70-90	1/3*	—	30	60-80	L-M
Cylindrical	5500-6500	0.0005	Wet	100-120	1/6*	—	12-17	60-80	L-M

*Denotes width of wheel face per revolution of work.

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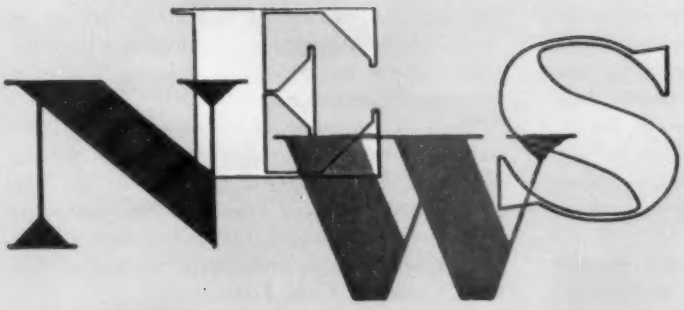


Informal congratulations which followed their formal swearing-in at the semiannual meeting brought smiles to the faces of the Society's five new directors.

Reading right from President George A. Goodwin are Bruce Fairgrieve, Francis J. Sehn, Cecil Chapman, Wilfred Pender and David A. Schrom.

report on SEMIANNUAL MEETING

"If there ever was a time when the influences of good tool engineering principles could be made to prevail, that time is now." These words by Harry E. Conrad, executive secretary of the American Society of Tool Engineers, set the pace for the proceedings at the semiannual meeting of the board of directors in Los Angeles, October 1 and 2.

The directors, recognizing the Society's obligation to accept the current economic challenge held out to the profession of tool engineering, proceeded cautiously but deliberately to effect every reasonable economy and to use available funds as efficiently as possible in mapping a strong program to meet this challenge.

The report of Treasurer Philip Marsilius, although reassuring in that "at this time the Society remains in a sound, healthy financial condition," further cautioned that the full impact of the sharp industrial recession would not be experienced until the fiscal year 1959. He explained that emergency reserves established some ten years ago would see ASTE through a short-term distress period, but that a longer emergency would necessarily involve deep cuts in expenses and activities. At present, the directors chose a path that involved little or no curtailment of the activities and programs identified with the ASTE which work to the benefit of its members and industry.

Among the new projects receiving board approval were: the initiation of a new annual publication, the Tool Engineer's Suppliers Directory; allocation of funds to purchase TV kinescopes on tool engineering and the publishing of books on aircraft assembly and machine tool numerical control.

Tentatively set for mid-February of this next year, a special meeting of the board of directors will be called to cover discussions of the proposed ASTE Science, Education, and Administration Center. The later meeting will accommodate the need for amassing data on site selection, favorable tax climate, and considered requirements and acceptance by industry for such a facility.

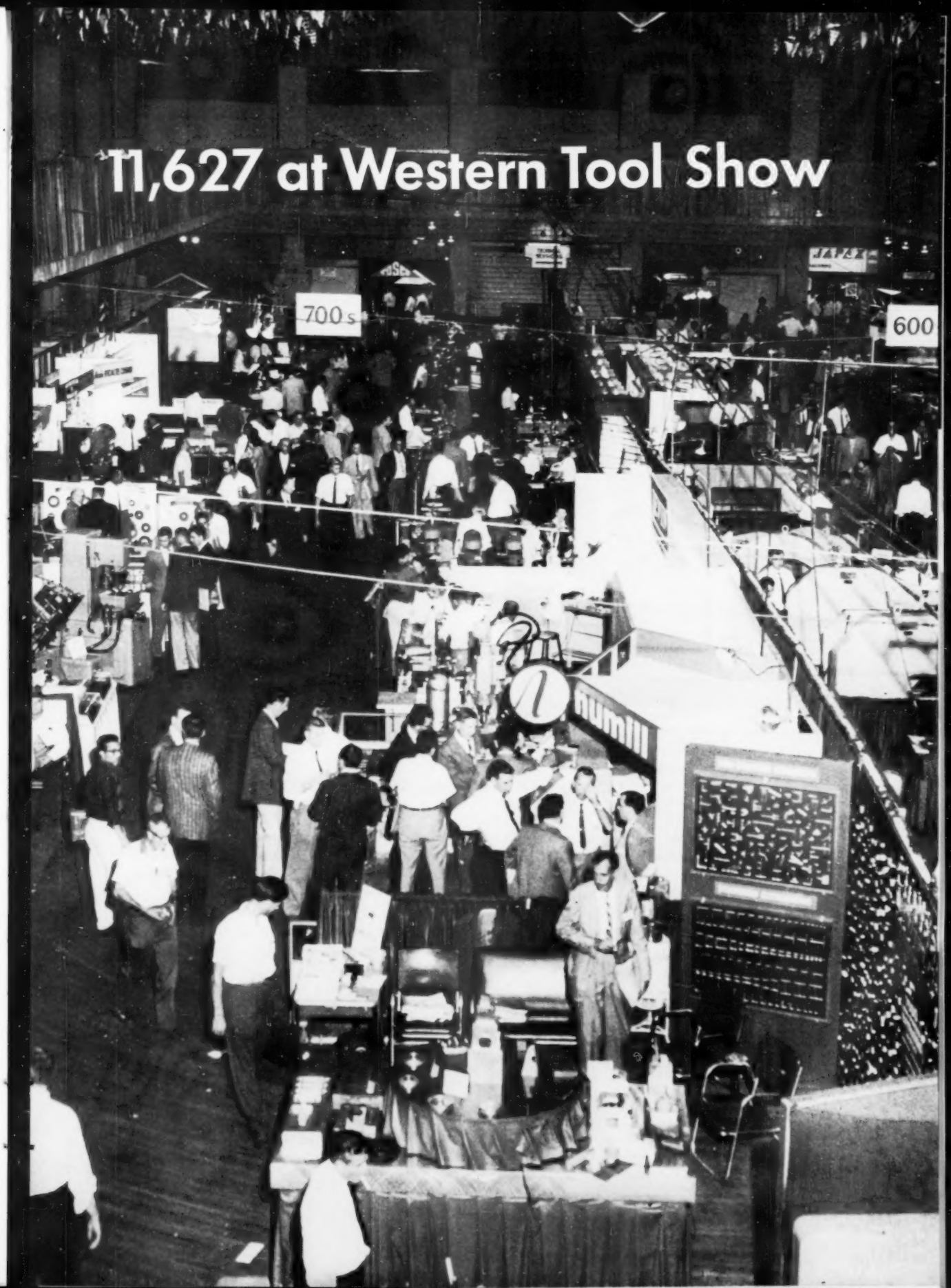
An informal report by Mr. Conrad on the recent meeting of the ASTE Research Fund Committee brought out the proposal to establish a $100 ASTE research associate level of membership for industry subscription, the proceeds from which would be channeled into a general research fund.

The 1958 addition to the Research Fund Committee was announced as Frank E. Myers, associate director of Argonne National Laboratories. Former dean of graduate studies and head of the physics department at Lehigh University, Dr. Myers will represent the educational and atomic energy interests of the committee. His election was unanimous, as was the reelection of James Weaver as chairman of the committee.

The annual nominating committee for candidates to the board was approved as consisting of William Moreland, Verne Loeppert, Ben Berlien, Carl Darger, Truman Coy, and Frank Ritchie. Immediate Past President Harold E. Collins will chairman the officers' nominating committee, comprised of Wilfred Pender and Frank Ford.

Action on a proposal made by the 1958 House of Delegates placed the question of establishing and operating a regional council system in national progress committee hands.

11,627 at Western Tool Show



Inside the L. A. Show

ATTENDANCE of 11,627 and estimated total sales of $4 million at the five-day ASTE Western Tool Show provided a shot in the arm to the manufacturing and production tool industry and to the economy as a whole.

ASTE Executive Secretary Harry E. Conrad hailed the success of the Society's second western exhibition, which closed Oct. 3, as "indeed gratifying. The large number of sales reported at both the western show and the regular show in Philadelphia last spring definitely indicates that, even in hard times, there is a great demand for the capital equipment that will enable management to effect savings in time, labor or materials."

It didn't take long for the 2000 people manning the 200 booths in Los Angeles' Shrine Exposition Hall to discern a major trend toward on-the-spot sales. A second-day stimulus was a $643,000 sale of 100 tracer units. As this and other sales indicated, there was significant interest at the show in ideas and equipment that are destined to play a large role in "Tooling for the Space Age," the show's theme.

Supplementing the educational aisles in the Shrine were technical sessions at which 50 papers were presented, and 13 plant tours of Los Angeles area installations. Aircraft plant tours were especially well attended.

Success of the Tool Show and its attendant events reflected in great measure the enthusiastic planning of the dozen California ASTE chapters, which represent 4,000 of the Society's 39,000-plus members.

Posing with City of Los Angeles resolution honoring tool engineers are ASTE President George Goodwin; City Councilman Edward Roybal, who presented the award at the California Day luncheon; Leo A. Carter, vice president of Douglas Aircraft Co., and Gov. George Clyde of Utah, speakers.

California Day

IN THE NEAR unanimous opinion of some 500 ASTE members and industrial, educational and civic leaders, the high point of the Tool Show week came at high noon on the first day. That was when Gov. George D. Clyde of Utah, speaking to the California Day luncheon on "Educational Requirements of the Space Age," proved himself to be a humanist, as well as an engineer and a public servant. He said:

"I am afraid that we the people have been softened by the abundant life that we have built—that we have suffered a weakening of our moral fiber, a loss of our spiritual aims, a softening of our physical and mental toughness . . . .

"I am afraid that a large part of our nation may have lost the ideal of the Great American Dream and slipped into the Great American Daydream. This daydream is the escape from reality that leads us to look to the Federal Government to solve our individual and group problems. . . ."

The governor called for a return to the three R's; for equal emphasis on technology and the humanities; for a long-range, realistic educational maturity instead of a Sputnik-inspired crash program.

In an eloquent ten-minute departure from text, Gov. Clyde warned that our technological progress has outstripped our spiritual growth, and called for a reversal of this trend and a balancing of our values if our civilization is to survive.

Sharing keynote honors was Leo A. Carter, vice president of Douglas Aircraft Co. An authority on space-age manufacturing, Carter stressed the need for technical teachers and demanded incentives to swell their ranks. Anticipating Gov. Clyde's appeal for a balanced approach to the new era, Carter said that "here we are worrying about the problems of radiation in space—and we haven't yet solved the problem of smog in Los Angeles."

Ogling an earthbound creature at the Western Tool Show is a little green man in a flying saucer, who dropped in on the Show because of his interest in "Tooling for the Space Age." Joanna Schnarr worked in the ASTE press room at the Shrine.

Gary Hughes, senior ME student at California Polytech and a member of the ASTE chapter there, demonstrates how to "weigh" show visitors on a simple beam employing strain gages. Seven other colleges maintained booths at the show.

Taking the measure of a 26-pound suit of armor, one of 51 made by Arrowsmith Tool and Die Corp. of Los Angeles for use in the motion picture "Joan of Arc," are (left) Ted Ewing, sales manager, and Tom Conlon, San Diego representative for the company. Ewing's brother Wayne is ASTE vice president.

Well-attended booth was the big one set up by 11 Canadian firms and subsidized by the Canadian government. A consular official in attendance said the country planned to repeat the unusual cooperative effort in South Africa and other industrial exhibit areas.

Grouped around slide projector just before start of a Biltmore Hotel technical session on quality control are (left to right) Gordon Lynwalter, chief engineer of Ultralab Precision Calibration Service, Los Angeles; Leslie S. Fletcher, ASTE research director; Larry O'Rourke, quality control engineer in Lockheed missiles division; and William R. Baker, quality control director, Parker Aircraft Co.

Talking over the news during a sidewalk pause outside the Shrine Auditorium are (left to right) Irving H. Buck of Dallas, ASTE director; Donald E. Zierk of Dundee, Ill., national editorial chairman; and ASTE Secretary C. M. Smillie, Detroit.

Ignoring the photographer in the ASTE center at the Tool Show are (back to camera) Gilbert E. Seeley, the Society's national education director, and Leon Bohrer, first vice chairman of Santa Ana Valley chapter.

Getting some vigorous applause from ASTE Vice Presidents David A. Schrom and H. Dale Long as he takes a bow at the seminannual meeting banquet in the Moulin Rouge is Los Angeles Host Committee Chairman John Stansbury.

Host chapter committee leaders pose during Biltmore Hotel reception held on eve of show opening. Left to right are John Stansbury, general chairman; James H. Medford, committee secretary; Edwin L. Cutler, vice chairman and a member of the national education committee; Raymond E. Garriss, committee secretary and chairman of the California Council of Chapters; and Lawrence D. Pomerantz, national program committee zonal member. Cutler is from San Gabriel Valley chapter; the others are in Long Beach chapter.

Table grouping at the get-acquainted tea included (left to right) Mrs. F. E. Anderson of Palm Springs, Calif.; Mrs. C. L. Almquist of Newport Beach; Mrs. A. E. Beaumont of Tarzana; Mrs. C. E. Scheurer of Los Angeles; Mrs. George J. Tilden of Burbank; and Mrs. William Jarvis of Portland, Conn.

convention candids

ASTE Director Bruce Fairgrieve (third from right) stands with three couples who were hard-working hosts during convention week. Left to right are Mr. and Mrs. Rudy Regen, Mr. and Mrs. John Stansbury, Fairgrieve, and Mr. and Mrs. Ed Cutler.

In the national spotlight

Santa Monica — Lucky 13th

Ralph Chrissie, vice chairman of the national membership committee, presents a membership kit to the fledgling chapter's membership chairman, William Pike, who had managed rather ably even without the kit, collecting 210 charter members for Chapter 153.

Ben Hazewinkel, chairman of Los Angeles chapter, pours words of welcome through the loud-speaker system before presenting his chapter's gift of a gavel to the Santa Monica charter chairman.

Santa Monica Chairman Ken Baucher (left) receives the traditional baby bottle which moves from one chapter to the next as each is chartered. Ray Garriss, chairman of the California Council of Chapters, made the presentation.

A REMARKABLE assortment of national officers, directors and committee chairmen, who had assembled on the coast for the semiannual meeting and tool show, turned out at the Surf Rider Inn in Santa Monica September 29 for the chartering of the ASTE's 153rd chapter.

Santa Monica, the 13th chapter in the state of California, started off with an impressive number of charter members—210. The new group could also be considered lucky because of the enthusiastic presence and backing of representatives from the dozen other chapters in the state.

The highest of all the ASTE officials present, President George Goodwin, administered the oath of office to: Ken Baucher, chairman; Harry Cornwall, first vice chairman; Harold Hanmer, second vice chairman; John Apalategui, secretary; and Cy Denny, treasurer.

Also on hand to bestow good wishes to the newest technical organization in his bailiwick was Santa Monica's mayor, Russel K. Hart. National Vice President Wayne Ewing was toastmaster, and the check for the chapter's portion of membership dues was presented by the junior past national president, Harold E. Collins. Other presentations included a desk set by Riverside Chairman S. P. Christoffersen; the charter by President Goodwin; ASTE trivet by Dick Bethune, chairman of the San Fernando Valley chapter; and chairman's pin by Ray Garriss.

Meet a Self-Made Prophet

by M. L. Stone
News Editor

Ed Cyrol

ONE OF INDUSTRY's most vocal prophets of doom is an ASTE member and erstwhile tool engineer named Edmund A. Cyrol, of Chicago. Despite his dour predictions, he's an energetic, smiling, ebullient, well-padded fellow who makes his living counseling others to think optimistically.

Indeed, it's a contradiction bordering on heresy that a man who has worked his way up from an "all-around" helper in Detroit tool shops during the Thirties to president of a leading engineering management consultant firm in the Loop today—who has just been elected president of the national Industrial Management Society, who is listed in three Who's Who's, who has been cited by a leading university for distinguished contributions to engineering—should be shouting from a rooftop in the financial district:

"America is on the verge of becoming a secondary power. . . .

"A country devoid of statesmen and top-heavy with politicians is placing the stress on the common man and is consequently becoming the common country—the second-rate nation. . . .

"A pathological quest for security and a punitive tax structure—these are the factors that are leading us into economic perils. . . .

"I believe our government economists are waiting with big clubs for the rat to come out of the wrong hole. . . .

"Generals always plan for the next war with the weapons and tactics of the last. We can't fight the next depression with the same weapons and tactics that would have prevented the last one. . . ."

Cyrol the prophet is not without honor in his own country, but the honors have not come because of such prophecies. They've come because of long hours of hard work.

That again is contradictory, in a sense, for an efficiency expert who tells others how to do more and more in less and less time.

"The eight-hour workday is not enough," he says. "It's just another symptom of a sick society. It takes twelve hours, or fourteen, or eighteen, to produce that extra something that is necessary for real success, real self-satisfaction."

Ed doesn't relish his sourness-and-dark role. He'd rather spend what leisure he has at his only hobby, the stock market, or at his only "avocation," baby-sitting for members of his staff. Or at loafing ("there's a medicinal value in doing nothing, but the doses are too seldom nowadays").

But Ed has been goaded into the role of prophet, within the last year and a half, by what he considers to be symptoms of capitalistic cancer.

Assails Destruction of Incentives

Earlier this year, in an address before the City Club of Chicago, Cyrol warned that the American people "seem to be bent on shaping our own country's decline through the destruction of incentives." Return to the basic principles that made us strong, he urged, or decline and fall. One of these basics is recognition of the fact that money is the most effective incentive to hard work and productivity.

"A toolmaker used to make $1.50 an hour; a sweeper, 50 cents an hour. Now the sweeper makes $1.90 an hour, and the toolmaker, $3.20.

"The changing ratio points up the cult of the common man that is jeopardizing our nation's survival. We are carrying the abstract idea of equality to the point where little or no incentive is provided, and success is penalized by the virtual confiscation of earnings."

Strangely enough, it is becoming necessary to

point out that the life-blood of a capitalistic economy is capital, Ed emphasizes. The first threat to investment capital is the fierce drive for security and the triumph of mediocrity.

The second great threat, the amateur economist believes, is the graduated income tax, which cuts the amount of money available for investment and kills the motivation to earn more by hard work.

"When private capital is no longer available to business, the government will provide it, of course; and manage the business; and take the profits; and we will no longer be the nation we now are.

"I am of the opinion that our government's financial condition is not rosy-cheeked healthy. The condition of any business that is having trouble borrowing money is always suspect: the U. S. Government is having trouble borrowing money at rates it considers proper. It has had to buy—through the Federal Reserve—its own bonds recently on a pretty large scale."

Ed admits that the popular economists of the day say we've licked the boom-and-bust cycle.

"They say there'll never be another depression, that we're on a high plateau and we'll go on forever with maybe a little time out now and then for a brief controlled recession.

"I don't think such economists know any more about the real causes of a depression than they did in 1929. The last depression followed a stock market crash. Therefore, control the market, control credit, clamp down on wild buying sprees, and everything will be fine, they insist.

"They are wrong, obsolete. The next depression will result from the deadly tourniquet squeezing off investment capital until it is in the hands of a few big firms, the inevitable slowing of technological advances and a decrease in management efficiency."

How does Ed propose to head off dark days? He has a five-point program:

- Reward the able by additional real income.
- Accept the idea that prosperity is created by productivity, not by manipulated credit figures. More money without additional productivity is only inflation. Productivity has not increased in this country as much as one percent during all the last two years.
- Get down to basics—give up what we cannot afford and use the savings to reduce taxes.
- Stop selling ourselves the idea that "we are the biggest, we are the best, we are ahead of all the rest."
- Stop to reconsider our directions, perhaps "change our management team." Get more women into politics and government. In the factory it is difficult to sell new ideas to men; they are followers. Women are generally realistic and willing to try new forms of action.

Cyrol's abrupt departure from the ranks of the business-is-bound-to-get-better boys is not out of character: for the sixteen years he has been an engineering consultant, he says, his job has essentially been that of a "needler," of one who differs

Taxpayer and postal critic Ed Cyrol exhibits four envelopes—sizes Nos. 6¾, 10, 12, and 90—which he recommends be made mandatory for first-class mailings. He estimates that this standardization would eliminate six manual sorts, and would appreciably cut the post office deficit.

with orthodox opinion and conventional approach.

Ed, now 42, has headed his own consulting organization for the past eight years. His six-man firm has eighth-floor offices on LaSalle Street, in the shadow of the Chicago Board of Trade, and his No. 1 secretary and accountant is his wife, Alyce. The company's specialized area of interest is the duties of the vice president of manufacturing. Among its clients are such firms as the Elgin National Watch Co., Underwood Corp., Stewart Warner, Whirlpool, American Machine & Foundry, and others large and small.

Ed is also a director of Federal Tool Corp., Chicago, and is listed with the Federal Mediation and Conciliation Service as an arbitrator.

He has written numerous articles for magazines, including several for THE TOOL ENGINEER, and a book, "Standard Data for Turret Lathes and Hand Screw Machines." A licensed professional engineer in the state of Illinois, Ed once was a shipping clerk with Studebaker Corp.; a time study man and later "watchdog" over excess costs in the Murray Corp. factory in Detroit; a tool engineer for the tool-up of the British Rolls Royce-Merlin engine at Packard Motor Car Co.; and a Detroit teacher of machine shop theory, mathematics and time study.

Taxpayer Speaks Up on Deficit

Ed admits his predilection to criticize, but he contends his criticisms are constructive.

Last winter, for instance, when the Post Office

Department was in its deepest deficit doldrums, taxpayer Cyrol came up with a program to "cut costs by 20 percent without losing efficiency, and stay in business."

"Any industrial engineer," he told the mailmen, "will agree that very few conditions exist in business today which do not permit a 20 percent reduction in labor and overhead costs through improved methods."

This saving would approximate $600 million annually—enough to wipe out the nearly $500 million postal deficit, and leave a handy $100 million for purchase of new equipment.

Persistence Wins Backing

Ed had four specific suggestions: use of time measurement and mathematical analysis as in industry, where such techniques reduce handling and housekeeping costs an average 42 percent; elimination of handsorting; request from Congress a budget to be spent only on methods research; and, if none of the first three suggestions were acceptable, that some private foundation come forward to set up a postal study project at some university.

Basic to his program was elimination of tedious hand-sorting by standardization of first-class-mail envelopes on the Nos. 6¾, 10, 12 and 90 sizes. Sorting could then be done in one step, by machine, instead of the six or seven manual sorts now necessary for each piece of mail. Ed also proposed a simplified addressing system along envelope margins, possibly etched in by card punch operators at post offices.

His persistence got his picture in the papers, made him some friends—and some enemies—and eventually drew a sizeable backing in official circles. He takes partial credit for recent development contracts on new automated sorting equipment.

Challenges for Tool Engineers

What does this perennial critic have to say about his fellow engineers?

Ed thinks the most challenging opportunity for engineers in general, and for tool engineers in particular, is preparation for management.

In an article entitled "Managerial Opportunities for the Tool Engineer," which appeared in the January, 1954, issue of this magazine, Cyrol wrote: "The man dealing primarily with people is generally better paid than the man dealing with things. . . . The tool engineer who is interested in mapping his progress should recognize this. He must become aware of the human relations side of industry."

More recently, to this writer, he said:

"If automation attains the levels we all think it will, the engineer will face his greatest test not in technology, but in the sociological sciences. If he does not meet this challenge, he may very well become the butt of future economic upheavals."

Tool engineer Cyrol (right) discusses an operation with Paul F. Sodayko, tool division superintendent at Federal Tool Corp., Chicago. Cyrol is a director of the firm.

In short, Ed thinks engineers must learn to be good mixers. They must learn to communicate, and to sell their profession.

A mechanical engineering graduate of the University of Michigan, Ed is proud of the fact that he was one of the few in his class who elected to take advanced composition and English. Traditionally, he says, many engineers have taken pride in their inability to write or talk persuasively; on the campus they have been the "roughnecks"; in industry they have been the "loners" who do their job and no one else's, and talk only to themselves.

Engineers have generally been a little lame in business, too, Ed thinks. He estimates that 80 percent of them cannot read a company's financial statement intelligently, and that fully 90 percent of them do not know accounting procedures. This can be rectified with a little effort, he asserts, either by formal college training, or night school, or do-it-yourself learning.

Opiate for the Underworked

"The do-it-yourself fad, by the way, is in my opinion an opiate for the young, bored, underworked population. If more people would spend their do-it-yourself energy in learning, maybe they would have castles to show for it instead of basement carpentry work."

Ed joined the ASTE in 1939, and in recent years has been a frequent speaker at chapter meetings in the Midwest. Asked what is wrong with the Society, he drew a deep breath, adjusted his glasses, and said:

"Nothing."

Johnson and Bassett, Inc. President J. E. Williams, left, checks pantograph engraving machine for use on metals with the newly elected vice president in charge of sales and engineering, Iver G. Freeman, a member of Worcester chapter. Freeman was formerly with Norton Co., Reed-Prentice, and Package Machinery Co.

F. T. Majewski

A. H. Johnson

John T. Bennett

Paul N. Stanton

members in the NEWS

The Hicks Corp. of Boston announces the appointment of **Frank T. Majewski,** Northern New Jersey, as executive vice president. Majewski was previously associated with the M. W. Kellogg Co., where he served as manager of the Rocket Div. This appointment comes as part of an expansion program inaugurated by the company some months ago.

Pratt & Whitney Co. has announced two new appointments: **Alfred H. Johnson** of Chicago has been named sales manager for their Cutting Tool and Gage Div. Prior to his new appointment, Johnson was located in Chicago as sales manager of the Mid-Continent sales territory. He will move to the main office, West Hartford, to direct all sales activities throughout the country. **Arthur C. Dade,** who has been a member of the Cleveland sales staff for 30 years, has been appointed cutting tool and gage sales manager for the Cleveland territory.

The appointment of **John T. Bennett,** Detroit, as sales manager has been announced by Gorham Tool Co. In his new position Bennett will direct the sales, engineering and service activities of Gorham field representatives throughout the country.

Paul N. Stanton, Boston, has been named manager of the Machine Tool Div. of Clearing Machine Corp. Stanton has an extensive background in the field of machine tool sales and manufacturing, and was formerly sales manager for a Massachusetts manufacturer of machine tools.

The appointment of **Norman H. Holland,** Chicago, as sales manager of Athol Div., Union Twist Drill Co. has been announced. He will be in charge of all sales, distribution, advertising and warehousing activities covering all metal tools manufactured at and distributed from Athol, Mass.

Edgar W. Engle

Edgar W. Engle, Chicago, development engineer with Kennametal, Inc., has been named manager of mineral industry products. Now in charge of the Mining Tool Div. at Bedford, Pa., Engle will also guide development of wider markets for the company's hard carbide products in mining and associated mineral industries. His wide experience in the development, manufacture and application of industrial carbide product uses has been gained through 18 years' association with the hard carbide industry. Prior to joining Kennametal he was technical director for Vascoloy-Ramet Corp. and was associated with the Carboloy Dept. of General Electric Company.

Johnson & Bassett, Inc. of Worcester, Mass., recently announced the election of **Iver G. Freeman** as vice president in charge of sales and engineering. Freeman was formerly with Norton Co., Reed-Prentice Corp. and Package Machinery Co. of East Longmeadow, Mass.

Jessop Steel Co. has named **William P. Youngquist** as assistant to the vice president-commercial to help accelerate the specialty steel producer's sales of tool, die, composite and specialty steels. He will also help to direct sales of Jessop's recently acquired subsidiary, Green River Steel Corp. of Owensboro, Ky. Youngquist was formerly associated with the H. K. Porter Co.

Long Beach members recently promoted by Grayson Controls Division are, from left, Lloyd Warner, now director of tooling and facilities; D. L. Graves, head of the tool engineering department; and C. B. Mitchell, new supervisor of tool engineering.

chapter news and views

Uses of the Atom Described At Fox River Valley Meeting

Applications of the atom in everyday life were described by an Argonne National Laboratory researcher at the Sept. 23 meeting of Fox River Valley chapter. Forty-six members and guests attended the session, held in the Veterans Club at St. Charles, Ill.

The speaker was Warren J. McGonnagle, group leader of nondestructive testing at the nuclear facility in Lemont, Ill. A Nebraska native, Dr. McGonnagle holds degrees from the Universities of Nebraska and Oklahoma, and went to Argonne from the faculty of Western Michigan College, Kalamazoo, where he taught three years.

He refused to talk about what he termed the overemphasized destructive role of the atom.

"If you want to know what this country has in the way of atomic weapons, read the Russian newspapers. If you want to know what the Soviet has in atomic weapons, read the U. S. newspapers." Then he added with a smile, "And if you want to know how both countries stand in the atomic race, read the Japanese papers.

"The future of civilization depends on the *peaceful* use of the atom. Otherwise, there could very well be no future."

Nowhere in the scientific and technological world is the need for manpower so acute as in the atomic energy field, McGonnagle said. He urged the tool engineers to think about nuclear engineering careers for their sons and daughters and to discipline their study from the fourth grade on, not the twelfth.

As examples from a wide range of atomic applications today, he cited the broadening use of radioactive isotopes to measure cutting tool wear and life. Such tests, he pointed out, are more reproducible and more sensitive than other tests, besides being faster and more efficient.

A prevalent use of radioisotopes is in gaging thicknesses quickly and accurately. Such gages are indeed shaping up as an integral part of quality control techniques in the automated factory of tomorrow, McGonnagle said.

The atom already is used for such things as measuring the paint wear of road pavement markings, and testing paving asphalts; measuring the water content of mountain snowfalls that furnish cities their water supply; finding leaks and measuring rate of flow in pipelines; measuring thickness and detecting defects of metal castings.

McGonnagle foresaw a surge in the commercial use of nuclear energy in the future. He admitted that the biggest problem to solve in adaptation of nuclear energy—to an aircraft, for example—was the tremendous weight of the necessary shield for the reactor.

Supply of uranium poses no problem, he declared; the United States is already mining uranium faster than it can be processed. In addition, the country is buying up the supplies from the Belgian Congo, world's No. 1 producer, to keep competitors from doing so.

McGonnagle illustrated his talk, which he entitled "The Atom's Use in Tool Engineering," with projected charts and schematic drawings.

—M. L. Stone

Potomac Members Hear "Big Guns Have Had It; Missiles Move In"

Potomac chapter had as its speaker, Captain Charles R. Briner, USN, superintendent of the naval gun factory, at the opening dinner of the 58-59 season.

Captain Briner took as his subject, "The Naval Gun Factory's New Look," striking a definitely optimistic note. His opening remark referred to his talk two years before when he stated that "the gun has had it" and that the gun factory was in a period of transition. "Today," he stated, "we are 75 percent converted and are in the process of making missile launching, storage and rapid handling equipment. We are also making antisubmarine devices, and have become a 'prototype plant' for the fabrication of the Sidewinder and missile launching devices." Regarding the Sidewinder, Captain Briner heaped kudos on William B. McLean, of NOTS, China Lake, Calif., for his imagination, ability and perserverance in bringing this weapon into being and insuring its acceptance by the Navy.

Substantial sums for modernization and rearmament will be spent in several areas of the Gun Factory. This planning will close the gun shop, the steel foundry and the forge shop, he explained, adding that an expansion program of the "weldery" had been embarked upon under the direction of David L. Lattin. There launchers for the Terrier, Tartar, Talos and other missiles will be fabricated.

Captain Briner emphasized the necessity for new ideas from workers at all levels to assist the Navy's engineers in new fields of development on such missiles and devices as the Betty.

—Henry C. Howells

FOX RIVER VALLEY—Discussing talk on peaceful uses of the atom are (left to right) Vice Chairman Walter D. Phillips; Warren J. McGonnagle of Argonne National Laboratory, speaker of the evening; and Chairman Ralph Keck. *—Colin Kyle*

TUCSON—Speaker John Featherstone, director of the University of Arizona's space project, gets a congratulatory handshake from Program Chairman Ray Olimski after talking on "The Computer and the Engineer." Behind Mr. Olimski is Coffee Speaker P. J. Martin, who spoke on the past, present and future of Tucson's water supply, from his vantage point as manager of the city's water utility. *—J. W. Vincent*

chapter news

Ballistic Missile Talk Draws 176 At Long Island

Richard Brast, Northeastern District representative of the Missiles and Ordnance Systems Dept. of the General Electric Co., was the technical speaker at the first meeting of the year, attended by one hundred seventy-six members and guests.

"The Air Force Ballistic Missile Program" was the subject of Brast's talk. The AFBM Program is the largest defense program in the country, Brast said, spending approximately a billion dollars a year. In addition to prime contractors, there are more than 200 principal subcontractors, and several thousand suppliers. A quarter million people are involved. There are 46 million square feet of floor space and 20,000 acres for static testing, totaling approximately ½ billion dollars in facilities, devoted to this program.

Brast described the two major categories of missiles: the aerodynamic, which flies within the earth's atmosphere and has wings and control surfaces; and the ballistic missile, which operates outside the earth's atmosphere and has fixed fins and is controlled by engine exhaust fins or a swivel engine. They are further classified by mission: offensive or defensive. However, no matter how classified, all missiles have four basic integral components: (1) propulsion system; (2) guidance system; (3) nose cone; and (4) airframe.

While these parts represent the integral components of a missile, Brast pointed out, the missile is only a part of the weapons system. The weapons system must provide the launching complex, including firing pods, ground guidance equipment, fuel, manufacturing, handling, shipping, testing and maintenance facilities.

Considering the complexity of the weapons system, the AFBM schedule established approximately four years ago was considering visionary at best. Today the program is on schedule with the Thor IRBM in production; the Atlas ICBM being flight tested; and the Titan development ahead of schedule.

Chairman Jerry Barfus acknowledged the efforts of the executive committee conducting chapter business through the summer months. Committee chairmen called for more help and participation of the membership. It was conceded that participation is a road to self-improvement as well as a contribution of time and effort to help the chapter attain its goals. *—W. Lamberta*

Schuylkill Hears Woman Consultant On Quality Control

Department Chief Bonnie B. Small, engineering consultant on statistical quality control for Western Electric Co.'s Allentown works, introduced members to basic charts and calculations in quality control at the Sept. 9 meeting. She discussed their applications as used, not only by engineers, but also by plant managers, top executives and businessmen in general.

Wes Sawyer, department chief of quality control at the company's Laureldale plant, acted as coffee speaker, and introduced Miss Small.

The meeting also marked the observation of Manufacturers' Association Appreciation Night by the presentation of gifts to the association staff. Donald K. Bassler, 1957 program and technical publications chairman, was awarded a certificate of service for his contributions in those offices. —*W. Robert Yeich*

Membership captains meeting to solve regional and local problems are, from left: Titus Zomborean, Phoenix; Clinton Holton, Denver; Fred Mondin, Portland; Joseph Koch, Sacramento; and National Membership Vice Chairman Ralph Chrissie, Los Angeles. Absent from the meeting were Art Hunter, San Fernando, and Ed Busher, Riverside.

Associate Editor Joins ASTE Staff

Robert S. DuLany has begun work as an associate editor in the technical publications department at Society headquarters. He is currently assisting in the compilation of the forthcoming "Handbook of Process Planning and Estimating."

A native of Detroit, DuLany came to ASTE from the Ford Motor Co., where he was a training specialist for three years. Before that he taught science for four years in the Detroit school system. He was a methods analyst in the manufacturing engineering department of Douglas Aircraft's Long Beach plant for a year, and interspersed a year of work in a tool and die shop during his college training.

DuLany

DuLany graduated from Wayne University in 1950, and took additional work for teacher certification in 1951.

Indianapolis

At the September meeting at the Antlers Hotel, 125 members and guests heard Robert C. Fisher, manager of abrasive sales engineering of The Cincinnati Milling Machine Co. give an interesting talk on "In and Outside the Grinding Wheels."

Area Captains Talk Membership Problems

The ever-present problems of attracting new members and holding the interest of all members were examined by Western area captains at a meeting called by Ralph Chrissie, national membership vice chairman, on August 15 and 16 in San Pedro, Calif.

A discussion of the quality of the chapter program and its effect on member interest raised the comment that occasionally an overlong occupation with routine chapter business cut short the technical speaker, and thus the main interest factor for those attending. It was proposed that chapter membership chairmen: encourage officers to adhere to a strict time schedule in conducting the business meeting; attend executive meetings completely prepared to discuss membership and its problems; and work closely with the program chairmen to insure the booking of programs of the most interest to the majority of members.

The question of whether there should be membership boundaries was answered by an emphatic "no," since this might confine or discourage members living in one chapter's area but working in another's. A polling of those present for individual comments and ideas brought the suggestion from Titus Zomborean of Phoenix that each chapter member be furnished with a blank membership application and asked to try to recruit at least one new member in a given period of time.

SOUTHEAST FLORIDA—Chairman Stan Petren, right, thanks GE Metallurgical Products representative Harry H. Jason for his talk reviewing ten years of machining problems encountered and solved, including the use of carbide and cemented oxide as cutting tools.
—*Thomas Morgan*

St. Louis

At the September 4 meeting, J. D. Kennedy and N. Matthews of the General Electric Co.'s metallurgical products department, diamond section, described diamond mining processes and marketing operations and discussed the impact of man-made diamonds on the diamond market and on industry. J. W. Ripple and J. Mueller of The Carborundum Co. told about the applications and limitations of man-made diamonds and how they compare with natural diamonds in cutting speed and efficiency. A new reduction of price was also announced which brings the cost of man-made diamond bort to within five percent of the market price of natural diamond bort.

BINGHAMTON—Distinguished group of Binghamites at a technical session on plastic steel consists of, from left: Chairman Charles King, Speaker Roger King of Devcon Corp., Charles Brink of Binghamton Industrial Supply, and Program Chairman John Kuharik. Speaker King demonstrated the mixing, properties, and uses of Devcon's plastic steel, supplementing the talk with slides on additional applications.

—John F. Arnold

Patent Laws and Gold Share Little Rhody Bill

Past history and present-day functioning of patent law was the topic of William F. Werner, a Providence, R. I., patent lawyer, speaking before Little Rhody members at the September meeting. Mr. Werner praised the writers of the Patent Act of 1835, which, with few amendments, is still in effect today. He described the investigations of government agencies connected with the Patent Office as being so thorough that there is little chance of the true inventor's rights being disputed.

An additional highlight of the meeting was a movie, "The Gold Filled Story," explaining the term "gold filled," and the preparation of gold filled stock. *—Alfred P. Dion, Jr.*

SANTA ANA—Joshua Gershuny (left) of Electro System, Inc.'s Electro Point Div., explains the electropoint positioning system as applied to a Burgmaster turret drilling machine. Program Chairman Ray Crouch is at right. Coffee talk at this meeting was concerned with raising and processing tobacco.

—Robert C. Gordon

DETROIT—Panel members of the September 11 gun and bore drilling symposium are, from left, T. W. Farron, Michigan Drill Head; F. S. Bloch, president of Eldorado Tool and Mfg.; J. S. Ladendorf, president, American Heller Corp.; R. L. Bearss, production engineering manager, Chrysler Engine Div.; D. E. Griswold, machine tool research supervisor of Excello Corp.; and J. Gabrick, program chairman of the chapter's carbide section. The symposium drew 150 members and guests. *—Ken Jenks.*

Positions Wanted

TOOL ENGINEER—or other responsible position in engineering (process, production, liaison), or procurement. Recent experience in Sub-Contract procurement of missile and aircraft components. Previous experiences in tool engineering, tool design, gage, die, and toolmaker; machinist for over 15 years. For full resume, please reply to Box 131, News Dept., The Tool Engineer, 10700 Puritan Ave., Detroit 38, Mich.

MANUFACTURING EXECUTIVE—General manager or manufacturing manager position desired by Midwest plant manager of appliance firm. Twenty-eight years' progressive advancement in small to medium plants; Purdue ME graduate; strong in manufacturing management and engineering; experienced in employee relations, labor negotiations, and public relations. Promise responsible and energetic leadership. Will relocate. Write to: Box 130, News Dept., The Tool Engineer, 10700 Puritan Ave., Detroit 38, Mich.

Position Available

IMPACT EXTRUSION PRODUCTION ENGINEER—Major aluminum company has opening for top man with extensive experience in all engineering and production phases of aluminum impact work. Excellent salary and benefits. Reply in confidence, giving experience and education. Write to: Technical Personnel, Box 47881, Los Angeles 47, Calif.

Missile Man Speaks At Golden Gate Meeting

At Golden Gate's September 17 meeting John S. Haldeman, supervisor of tool design at the Lockheed Missile System Division, discussed the extreme precision necessary in forming and joining the various stages of missiles. A slight misalignment, he explained, would cause a skin to protrude a few thousandths of an inch, resulting in skin friction great enough to weld the parts together from the heat produced.

Haldeman

Haldeman heads the tool design department of the company's Sunnyvale plant. *—G. Kenneth Dunn*

Obituaries

Axel A. Carlson, Seattle, tooling engineer for Boeing Airplane Co.

William B. Greener, Lansing, engineer for Federal Mogul Corp.

tomorrow's tool engineers

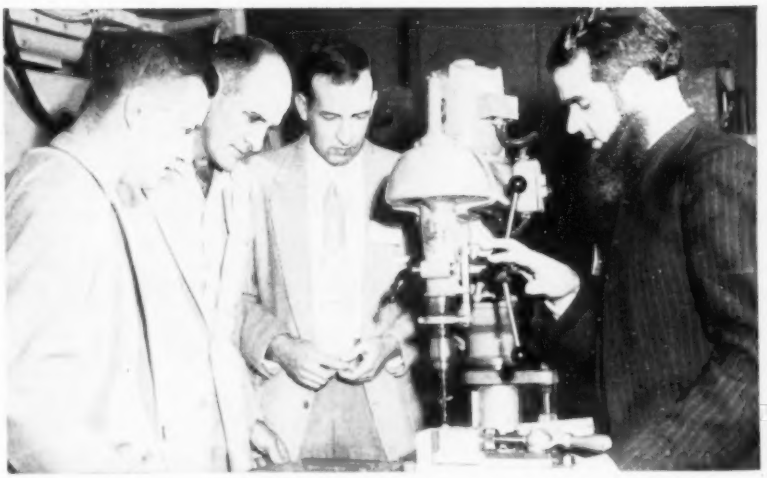
Purdue Chapter Boasts Active Participation

The Purdue student chapter of the ASTE bears out a point long held true of the Society as a whole—that its members are *active*, not just passive "belongers." Although quite a bit smaller than many other professional societies on the campus, the ASTE unit boasts an impressively high percentage of turnout at its meetings.

Chairman Mel Miller attributes this partially to the fact that the students who join ASTE have, for the most part, been exposed to tool engineering through work experiences and have a genuine interest in the field, rather than join because "most of the fellows in their school belong." There is, as yet, no school of tool engineering on the Purdue campus, and thus no artificial stimulus or pressure to join the society that represents a particular engineering school, either by faculty or "love of conformity."

Tours were a big drawing card in 1957-58, and plans for a more extensive two-day trip to a large out-state plant are in the works for the coming season, just now underway.

Cooperation with the Indiana Council in sponsoring the sixth annual on-campus conference was one of the major activities of Student Chapter No. 6 last April. Members welcomed and served coffee and donuts to conferees, and took over machine shop demonstrations in the up-to-date Michael Golden Shops, in addition to giving help in the planning and setting up of the day's events. Faculty Advisor Orville Lascoe is on the national education committee.



Indianapolis members Richard Allen, George Craig and Thomas Woods, attending the '58 Purdue On-Campus Conference, watch as Louis Brubaker of the co-hosting Purdue student chapter demonstrates a drill press in the machine tool lab.

Dr. R. Mallett, executive dean of Purdue (left) and visiting National Education Chairman Art Gould, head of industrial engineering at Lehigh University, take time out between conference sessions to discuss the student ASTE activities with Purdue Chairman Mel Miller.

The ASTE booth at the All-Campus Activities Carnival helped publicize the group's activities and attract new members. Members checking out the display are, from left: Louis Brubaker, Richard Leshuck, Dick Jankowsky and Mel Miller. Personal invitations to attend tours or technical sessions also proved to prospective members that the ASTE was a *doing* rather than a *do-nothing* organization.

chips and chatter

Cincinnati

Malcolm F. Judkins, director of New Product Development of Firth-Sterling Inc., spoke to 75 members and guests at the September 9 meeting at Engineering Society Headquarters. His subject, "Industrial Nuclear Power" consisted of the special problems and material that require solution and development before domestic nuclear power can become a reality. There followed a brief discussion of nuclear physics, as well as a summary of the types of power reactors, both presently operating and under construction, and the economics of nuclear power, in this country and abroad.

A plaque from National Headquarters was presented to Past Chairman Jim Frederick for his efforts to better our Society.

Oakland County

"Tracer Control Machining," presented by the Alray Mfg. Co., was the subject of the September 18 meeting at Devon Gables. Executive Vice President Walter Herreman, Sales Manager Vincent Coombs and Research Engineer Sal Cudnokufsky showed movies of their unique tracing mechanism in operation, and typical machined parts were on display.

Santa Clara Valley

Robert W. Hill, general manager, Methods Engineering Council, Div. of H. B. Maynard Co., was the speaker at the September 16 meeting held at Sabella's Restaurant in Sunnyvale. His talk was on the subject of methods time measurement as applied to jig and fixture design. In applying time measurement to establish the best method for doing a job, Hill said, the job must be analyzed by preplanning and predesign of tools before production starts.

NW Pennsylvania

On September 20 some 50 members and guests of the chapter studied manufacturing operations and methods at the Johnsonburg Paper Mill of the New York and Pennsylvania Company. This tour, organized by Chapter Chairman Ted Smeal, afforded an excellent opportunity to see paper making in its entirety, from tree to finished rolls of paper. The Johnsonburg mill produces paper for the Curtis Publishing Co., for such magazines as Saturday Evening Post, Holiday and Ladies Home Journal, and has a productive capacity of 250 tons of magazine stock every day. Official hosts were Henry Bell, plant superintendent, and Fred Callahan, personnel manager.

Cleveland

"The Tool Engineer and Management" was the title of a talk given by David A. Schrom, national vice president of ASTE, at the September 11 technical meeting held at the Cleveland Engineering and Scientific Building.

Evansville

"How the Industrial Design Engineer Works with the Tool Engineer" was the subject of a talk by Don Daily, industrial design engineer, Don Daily & Associates. His presentation impressed upon the audience that functional requirements, and feasibility of manufacture and utility, as well as over-all attractive appearance, must be weighed carefully in every decision affecting the design of tool or product. The talk was illustrated well by Mr. Daily with "before and after" design photographs.

Paterson

The sixth annual picnic was held August 16 with approximately 200 members and guests present. Food was served continuously, and many games were played, including egg throwing, horseshoes, baseball, etc.

Mississippi

At the September 8 meeting in Jackson 41 members heard William Lamb give a talk on "Precision Casting." He recounted the history and methods of producing investment castings, covering a variety of types and intricate forms and shapes used in aircraft, jewelry and dentistry. Slides illustrated the advantages of precision casts over wrought metals, and samples of all types of investment castings.

Erie

Forty-five members heard John Wilson, vice president of Thompson Grinder Co., speak at the September 9 meeting. Mr. Wilson, using slides and talking on "Application of Grinding Wheels," showed how grinders are being used more frequently in mass producing many parts which previously were done by some other methods. He mentioned that entirely new methods must be found in working the new metals which have recently been developed.

Ann Arbor Area

At the first meeting of the season, O. J. Seeds, manager of Cerro de Pasco alloys department, spoke of the many industrial applications of bismuth and its alloys which, before World War II, were largely limited to pharmaceutical products. He showed how the alloys are used in X-ray research and how plastics can be molded in dies made of the alloy, even though the plastic compound is at a higher temperature than the melting point of the die, by watercooling the die.

Leslie F. Schwanbeck, production planning manager for Argus Camera Div. of Sylvania Electric Products, spoke about procedures used in transferring a product from the design state to production at the local industry.

Monmouth

There were 80 members present at the September 9 dinner meeting at Old Orchard Club. "There Is Nothing to It" was the disarming title of a talk given by John Schmahmann, sales engineer with the Nicholson File Co. Methods of file manufacture, types and techniques shown left the impression that the title might well have been "There Is Much to It."

Keystone

"Ceramic Tooling, Is It Ready?" was the title of a talk given by Edward Kibbit, manager of Stupalox Project, New Products Branch, Research & Development Div. of The Carborundum Co., to about 45 members at the September 15 meeting. Mr. Kibbit compared progress of ceramic tooling in Europe and Russia with that in the United States. Several case histories and examples of the use of ceramic tooling were cited. Robert Dawson, director of Penn State Institute, Div. of Penn State University, was the coffee speaker, describing various courses offered and service value to industry and community.

SPECIAL EVENTS

ASTE 27th Annual Meeting.
April 18-22, 1959, Schroeder Hotel, Milwaukee, Wis.

Springfield, Ohio

Sixty-four members met September 9 at the Oakland Presbyterian Church for a dinner meeting, where they heard George A. Goodwin, national ASTE president, speak on "Industry and Education." Other speakers were the Rev. Father Victor Ries, Catholic Central High School; Herman Seaman, Springfield Senior High School; and Frank White, Wittenberg College, who represented education; John W. Spencer, Steel Products Engineering Div., Kelsey-Hayes Co.; Eugene Ritter, Springfield Machine Tool Co.; and Paul Rechnagel, Rechnagel Machine Products, who represented industry. Glen R. Weikert, local public relations director for the International Harvester Co., served as moderator.

Monadnock

"Design and Manufacture of Better and Cheaper Mousetraps" was the subject of a talk given by Harry I. Dixon, president of Metallurgical Products Co., at the September 18 meeting at the Ellis Hotel. Mr. Dixon spoke on the economics and techniques of new die design and casting methods. Slides showed many aspects of manufacturing parts heretofore considered too complicated and expensive to produce economically. The methods described were investing, frozen mercury, and the lost wax casting processes. Examples of some of the processes were on display to show the difficult problems involved.

Hamilton

Seventy-five members enjoyed a plant tour of Anaconda Brass Co. of New Toronto September 11. They were welcomed by Ernie McKee, the chief draftsman of the company. The 32 acres of plants were toured in groups of five. They visited casting shops where the ingots are poured, the machine shop where the 32-inch-diameter rolls were being ground, and toured the rod and tube mills and the sheep mills.

Long Beach

Ninety members and guests were present at the September 10 meeting held at the Petroleum Club. The meeting was highlighted by an interesting and informative panel discussion on bearings and bearing applications.

CHAPTER MEETINGS

PLACE	Nov	SPEAKER	SUBJECT
Akron. The DoAll Co.	18		The Story of the Cutting Edge
Cedar Rapids. Dinner, 6:30 pm technical session 7:30 pm	13	**John Press,** Federal Tool Co.	Tool and Die Estimating
Chicago. Nielsen's Restaurant. 7 pm	10	**Byron L. Friend,** Telcine Studios	Magnifying Time: Industrial Photography
Cincinnati. Engineering Society. 8 pm	11	**M. R. Prather,** The Cincinnati Die Casting Co.	Precision Die Casting
Cleveland. Cleveland Engineering and Scientific Bldg.	13		Used Machinery
Des Moines. Country & Golf Club. 7 pm	12	**Harry Deerwester,** Elox Corp.	Electrical Discharge Machining
Detroit. U. S. Rubber Co.	20		Plant tour by combined carbide, automation and educational sections
Elmira. Mark Twain Hotel. 7 pm	3	**Leo Strauss,** Amer. Mach. & Foundry Co.	Creativity in Design
Erie. East Erie Turners. 7 pm	11	**Rev. Wilfred Nash; Nat'l VP Dave Schrom,** Borg-Warner Co.	Industry and Education
Hamilton. Brant Hotel. 6:30 pm	14	**Representative of B&W Heat Treating Co.**	Heat Treating
Hartford. Pratt & Whitney Machine Tool Co., Men's Club Bldg. 8 pm	3	**Chester S. Johns,** Buhr Machine Tool Co.	Automation: Design, Construction and Development
Hendrick Hudson. Otto's Restaurant. 7 pm	22		Annual dinner dance
Indianapolis. Fisher Body Div., General Motors Co.	14		Plant tour
Indianapolis. Antlers Hotel. 6:30 pm	6	**Nevin L. Bean,** Ford Motor Co.	A Look at Automation in Russia, Executive Night
Kalamazoo. Western Michigan University Center. 7:30 pm	20		Panel discussion, featuring spot, heliarc, arc, brazing and soldering
Lansing. Civic Center.	11	**Representative of DoAll Co.**	Joint meeting with A.S.M.E.
Little Rhody. Johnson's Hummocks Restaurant. 6 pm	6	**George A. Hutson,** Watervliet Arsenal	Trepanning—Tooling and Equipment for workpieces too large to rotate
Long Island. Garden City Hotel	10	**William Losee,** N. Y. Telephone Co.	The Solar Battery
Mississippi. King Edward's Hotel, Jackson. 6:30 pm	3	**To be announced**	Coolants and Cutting Fluids
Montreal. Canadian Legion. 7:45 pm	19	**George Barnes,** Northern Behr-Manning Overseas, Inc.	Ceramic Tooling
Muncie. Delaware Hotel. 7 pm	11	**Robert Kessler,** Delco-Remy	European Industries
New Haven. Oakdale Tavern	11	**Otto Winter,** Beardslee and Piper Co.	Shell Molding
Niagara District. Atlanta Club. 6:30 pm	6	**D. G. Huber,** McMaster University	Education and the Tool Engineer
Northern Massachusetts. Mansion House. Dinner, 7 pm.; meeting, 8 pm	18		Annual educational and executive night
Northwestern Pennsylvania. Emporium Moose Club. 6:30 pm	6	**Frank L. Allen,** Charles Bruning Co.	Optical Tooling
Oakland Co. Selfridge Field.	22		Conducted tour
Peoria. Timberlake Country Club. 7 pm	21		Movie, "Trip Through 10700 Puritan"; Election of Nominating Committee
Pittsburgh. Gateway Plaza—Golden Triangle. 6:30 pm	7		Wind-up meeting of Small Tools Seminar. "Stump the Experts" panel
Portland (Ore.). Owens Illinois Glass Co. 7 pm	13		Plant tour
Rochester. 8 pm	3	**George Kirkley,** Electric Boat Div., General Dynamics	Electric Boat Insert Weld
Santa Ana Valley. Palms Restaurant, Anaheim. 7 pm	11		Management night
Santa Clara Valley. Sabella's Restaurant. 8 pm		Frank Menard	Transfer Presses
Schuylkill Valley. Hotel Traylor, Allentown. 8 pm	21	**Malcolm F. Judkins,** Firth-Sterling, Inc.	Joint meeting with **Lehigh Valley**
St. Louis. Ruggeri's Restaurant. 8 pm	6		Panel discussion
Tucson. The Tucson Inn. 7:30 pm	11	**Ben Berlien,** ASTE Director	Present-Day Alloys and Their Heat Treatment. Line-Up for Tucson Industrial Night
Twin Cities. Coleman's Restaurant. 5:30 pm	5	**Representative of Gisholt Co.**	Superfinishing and Balancing; Past Chairmen's Night
Wayne State University.		**Carl Anderson,** U. S. Lake Survey Team	Talk on St. Lawrence Seaway survey
Worcester. The Hickory House. 7 pm	25	**Leo T. Doherty,** Worcester Supt. of Schools	

V-R Multiple tooling cuts at BOTH 450 and 113 s. f. p. m.

How V-R Carbide and TANTUNG® cast alloy gang up to solve cutting problems

PROBLEM: How to bore 2" I.D. at 113 SFPM while turning 8" O.D. at 450 SFPM.

SOLUTION: A V-R toolholder and throw away insert will perform perfectly on the 450 SFPM O.D. but the 113 SFPM boring speed demands the cutting qualities of V-R TANTUNG cast alloy. TANTUNG is especially engineered for speeds between carbide and High Speed Steel.

V-R Carbide and TANTUNG make a perfect tooling team to solve this and many other cutting problems. Ask your V-R Representative or write for complete information. V-R Engineers will be glad to work with you on all of your cutting problems.

25 YEAR

V-R Vascoloy-Ramet corporation

PRIME MANUFACTURERS OF REFRACTORY METALS ENGINEERED FOR THE JOB

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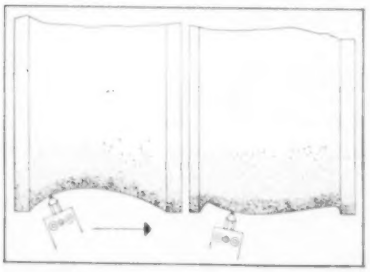
Progress in Production

SINGLE DIAMOND DRESSES DOUBLE GRINDING WHEEL

Wheel dressing of complex contours and double wheels has been speeded up by a single-diamond technique. As evidence of its successful application, airfoil lugs on jet engine blades are being contour ground two at a time to 0.0002 in. with only one diamond used to dress the double grinding wheel. Doing the job is a unit developed by Hoglund Engineering & Mfg. Co. and installed on a surface grinder at Thompson Products' Jet Div. Now a 41-machine grinding department is producing seven different blade sizes for Pratt & Whitney J-7S engine.

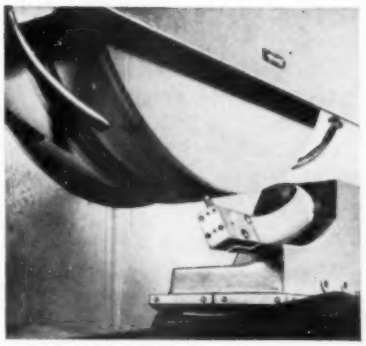
Key to dressing accuracy is cam-control of the diamond so that its point remains normal to the wheel face during the dressing cycle. After about 50



Cam action in the dresser causes diamond to rotate about its own point during traverse across wheel. The diamond thus remains normal to the wheel surface at all times.

air foil lugs are ground, the dresser moves into position under the double wheel. Dressing cycle of the diamond starts at the left-hand corner and proceeds to the right-hand corner. As it traverses the wheel face, the diamond is pivoted about its own point so that it is always at a right angle to the face.

Inside the dresser is a hydraulically-powered slide which mounts two templates: a contour template to control diamond movement in and out of the wheel during traverse; an angular position template to rotate the diamond.



Contouring accuracy stems from wheel dressing provided by Hoglund contour wheel dresser having single diamond.

Action of a follower on the contour template is reduced to diamond movement through a 10:1 inclined plane cam. This assures the 0.0002 in. repeat accuracy. A follower on the angular position template transmits motion to a rack and pinion assembly which simultaneously rotates the diamond.

COLD FINISHED STEEL OFFERS EXTRA RESISTANCE

Economy in production of wear resistant parts is stressed with introduction of a new high-strength, free-machining bar steel. The stress stabilized, cold-finished metal, produced by Jones & Laughlin, ordinarily needs no heat treatment during fabrication. Several important properties are claimed for the Jalcase 100 grade because of an advanced processing technique which stabilizes and balances internal stresses. Stress control thus attained prevents unbalanced stresses which often bring about distortion of high-strength steel bars after machining operations.

It has a minimum yield strength of 105,000 psi in round sizes of 1½ in. diam and smaller (or 100,000 psi for 1½ to 3 in. inclusive, or 90,000 psi over 3 in.) Minimum hardness of the steel is 248 Brinnell in round sizes up to 1½ in. inclusive and 241 for larger sizes. Chemical analysis is equivalent to AISI grade C-1144.

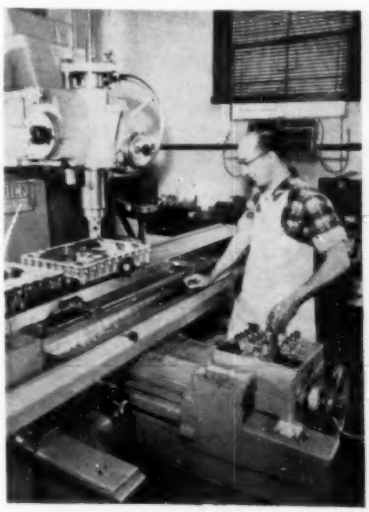
TABLE TRAVEL SERVES AS KEY TO JIG BORER CAPACITY

Recognition of an often overlooked basic point—table travel—has been an important factor in saving 300 hours on an 800 hour precision boring job for Triangle Tool Co. Now making use of table travel enables loading and machining two parts at a time, simplifying setup and keeping the machining operation moving, once started.

In selecting equipment for his operations, B. Solomon of Triangle found that the Fosmatic jig borer's table travel of 48 in. longitudinally, 22 in. laterally, gave him ample room for loading either extra large parts or two or more average size parts.

The machining problem was an aluminium alloy gearbox calling for more than 200 precision holes, boring, spot facing, recessing, milling, tapping and counterboring. Hole sizes range from ¾ to 4½-in. diameter. Until this time each unit, consisting of two mating halves, required a toal of 800 hours.

With increased travel capacity, and the positioning accuracy and ease offered by the new equipment's automatic positioning and direct dimension measuring, job time was cut to 500 hours per unit. Over-all precision require-



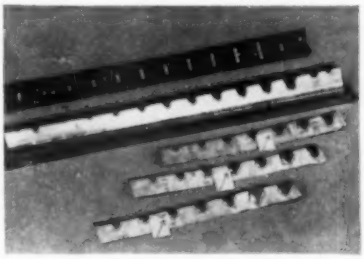
ments were ±0.0002 in.

Because of operator skill and the machine's simple concept, hole size and location were held to ±0.0001-in. accuracy.

The machine's direct dimension measuring system consists of two direct reading drum dials, on which the operator sets dimensions direct from blueprint. Because of the simplicity and directness of the procedure, there is almost no possibilty of operator error or confusion. At the press of a button the table automatically positions itself on X and Y coordinates, accurate to ±0.0001 in. The same operation can be numerically controlled by punched tapes or cards.

SIMPLE ELONGATION DEVICE PREDICTS FORMING LIMITS

Limits for forming can be predicted accurately with a surface elongation device developed at Chance Vought Aircraft to simplify forming of high-strength aircraft and missile metals. The device is comprised of a male die dimpled to various depths and a female V-shaped die. A metal sample is placed between the dies in a press and pressure placed on the dies. Pins in the female die press the metal into the dimples. Result is a series of progressively deeper corner beads. The deeper the bead, of course, the more elongation that has been required. The difference in each corner bead is controlled and requires one percent less elongation for forming without fracture than the adjacent bead. This simplifies measurement of surface elongation to counting the number of unbroken beads. Because elongation measurements are independent of edge conditions, the metal coupons used in test need no special edge preparation.



At top of the photo are the two components that make up the matched plate surface elongation testing die. The three samples which are shown below the die show surface elongation of 12, 11 and 10 percent (from top to bottom). This may be checked from the different number of beads that are formed without cracking as indicated by arrows, with the rule for measuring percentage of surface elongation being a counting of the unbroken beads.

OUTLINE SOLUTIONS TO THREAD GAGE CONFUSION

Correct terminology, standard practices and specifications of special thread gages often are confused in user's minds, it has been pointed out, because of differences between manufacturers. T. J. Owen, a thread gage specialist at Size Control Co. has compiled a series of suggestions which may overcome the problem.

When ordering standard gages, he says, only size, class and tolerances need be specified. Stating required pitch diameters on standard gages only makes extra typing and offers possibility for mistakes.

Because AGD standard specifications now also refer to reversible thread plug gages as well as taperlock plug gages, a customer can simplify orders by stating only size, class and tolerances of desired gages, then requesting that the gage be manufactured to AGD specifications. This eliminates need for excessive defining of dimensions.

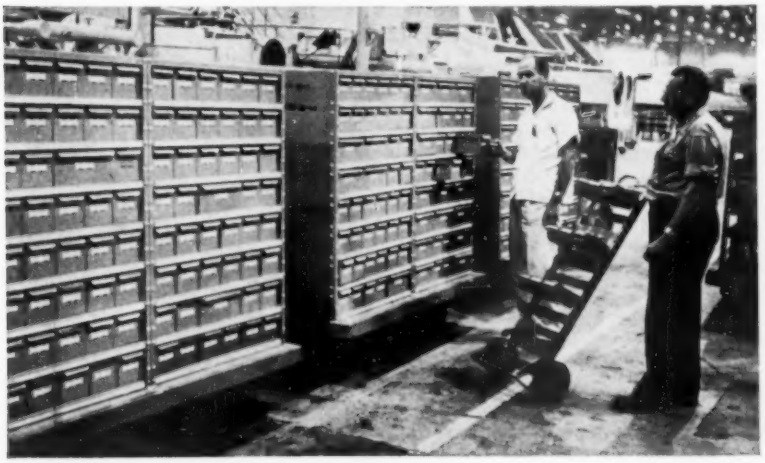
Many engineers ordering special gages are specialists in other engineering fields; they are not thread gage specialists and are unfamiliar with precise terminology and standard practices. In such cases, Mr. Owen ventures the suggestion that a firm might be able to place such confidence in a precision thread gage manufacturer, that it would allow that manufacturer the authority to make necessary changes in blueprint or specifications as needed. Pursuing this possibility, alliance with a competent manufacturer would provide a firm with a constant and standardized method for procuring precision thread gages to exact specifications.

MOBILE SUPPLY TRAIN PROVES MULTIPLE ECONOMY

Switch from a general stores setup to a mobile train arrangement to supply hardware to various departments is saving Chance Vought Aircraft substantial time and money. The "hardware train" consists of a tractor pulling three trailers on which are built several hundred trays, each holding one or more types of items. Six of the trains work continuously to keep the plant supplied from the 5300 different kinds of nuts, bolts, screws, washers, rivets and gaskets used to make the F8U Crusaders and Regulus guided missiles.

Because the hardware now travels to the departments, paper work and running around required to draw such items out of general stores has been cut tremendously. The company calculates that an estimated 15,720 man-hours a year are saved by the elimination of writing, posting, checking and tabulating of up to 40,000 requisitions a month. Other advantages have been reduction of floored hardware, leveling of stock balance where shortages exist, reducing factory aisle traffic, elimination of congestion and time waste at main stores stock windows. The company points out that as soon as the trains went into operation, tons of hardware were turned back to main stores.

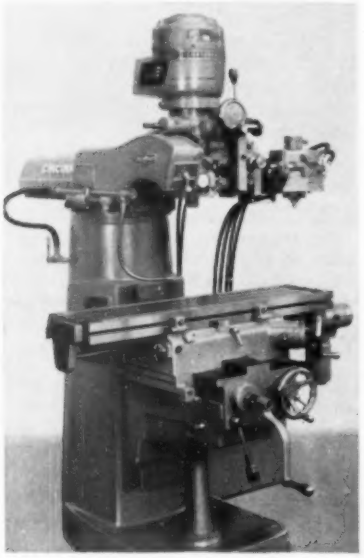
Rounds of the plants are made nightly by the trains. Color codes in the supply trays of each work unit inform the train operators of stock needs. Trays in a given unit, for example, may carry a white tab to indicate the bin should be filled, a green to indicate half full or red to show desire for quarter full. During the day the trains are parked in assigned spots where employees can go to pick up needed hardware without requisitioning. Once a week the trailers are loaded by the main stock room and punched cards are filled out and sent to materials control so an adequate supply can be maintained in stock.



TOOLS of today

Contour Milling Machine

The Contourmaster milling machines, designated 1C, is equipped for three-dimensional hand guided hydraulic tracer controlled milling. It controls direction of traverse of the table and saddle for 360-deg horizontal profiling, and vertical movement of the spindle quill for vertical profiling. Deflection of the stylus results in a corresponding separate or simultaneous movement of the table, saddle, and spindle quill. Horizontal feed rates of 360 deg, within the limit fixed by a knurled adjusting



dial, are controlled by the amount of tracer finger displacement: a maximum of 25 ipm may be obtained. When the tracing unit and quill are in the fully retracted position, a rapid traverse rate of 50 ipm is available for positioning the table and saddle. Of course, the conventional handwheel controls can also be used for positioning.

A vertical feed adjusting dial determines maximum "down" feed rate of the spindle.

Four combinations of feed movements are available: (1) All three movements "active" for complete three-dimensional control; (2) Vertical movements "blocked out" for 360-deg profile milling in a horizontal plane; (3) Cross feed "blocked out" for depth control milling, using vertical feed and table feed; (4) Table feed "blocked out" for depth control milling, using vertical feed and cross feed.

Power feed in a straight line, using the table or cross traverse, can be engaged without constant hand deflection of the tracer finger. A device mounted on top of the 3-D unit, holds the tracer finger in any deflected position. A control knob engages and disengages the mechanism.

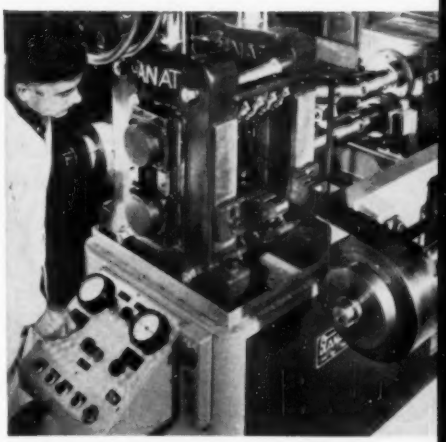
In one setting, the full 22-in. table travel and 10-in. cross travel can be used for 360-deg hand-guided profile milling cuts. Ram mounting of the spindle carrier permits milling of work wider than 10 in. in two settings. Vertical range of the spindle quill is 3½ in. Eight speeds range from 215 to 5650 rmp.

The Cincinnati Milling Machine Co., Cincinnati 9, Ohio. **T-11-1**

Reversing Strip Mill

Principally for use in specialty order shops and pilot production plants in both ferrous and nonferrous industries, this design permits economical installation of a complete reversing mill facility. The reversing 2-high/4-high combination mills range in roll size from ¾ and 3 in. x 4 in. to 4 and 16 x 20 in.

The two-way strip winding mechanism comprises both a payoff and a recoiler which are bracketed to the mill base and driven from the pinion stand. Powerful air clutches furnish sensitive control of front and back tension over a wide range. Accurate reproducibility



of tension is provided by calibrating in terms of air pressure. An operator's console, mounted to the base of the mill, is included in the package.

The reversing strip winding mechanism was also designed for adaptation to many of the Stanat 2-high and 2-high/4-high combination rolling mills in the field.

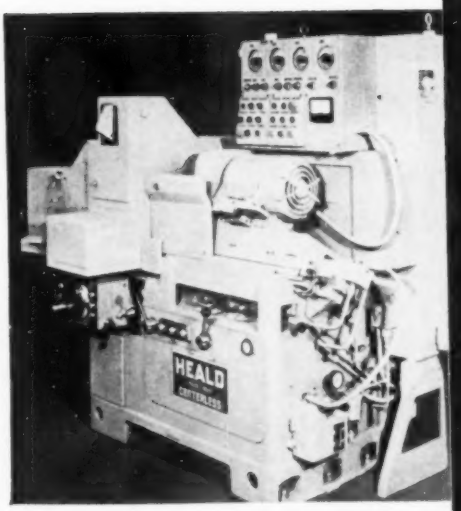
Performance tests show the reversing mill successfully reducing stainless steel, platinum, gold plate, nickel and molybdenum strip.

Stanat Mfg. Co., Inc., 500 Shames Dr., Westbury, N. Y. **T-11-2**

Internal Grinders

Two internal grinders incorporate Rite Angle design (in which the table is inclined at an angle of 30 deg to the work) to prevent any tendency to lift when work is fed into the wheel. This achieves solid wheel backing to take heavy pressure, true table tracking, good swarf and coolant drainage, and a superior base for mounting wheelheads.

Model 180A roll type centerless machine (illustrated), accommodates



small to medium size work that can be rotated on its own OD. It will handle work with ¾ to 4½-in. OD and grind holes up to 3 in. long. Maximum included angle of taper on Size-Matic type is 60 deg.

Model 170A chuck type internal, high-production machine permits automatic chucking of small to medium size work that cannot be rotated on its own OD. The machine handles work up to 4½ in. OD, with maximum hole length of 2 in. and maximum hole diameter of 2 in. It has 10-in. swing inside hole and 7½ in. table travel.

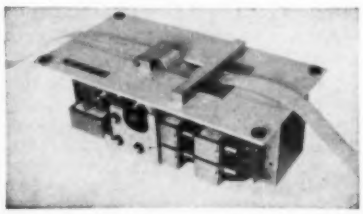
Given a proportionately stiff quill, the machines can grind as fast as the wheel and work will take the load. All workholding and sizing components are interchanegable.

The Heald Machine Co., 2 New Bond St., Worcester 6, Mass. **T-11-3**

USE READER SERVICE CARD ON PAGE 175 TO REQUEST ADDITIONAL TOOLS OF TODAY INFORMATION

Tape Punch

Designed for either console or rack mounting, this motorized tape punch operates on a single cycle basis and can be operated at any speed up to 27 cycles per second. Any width oiled or nonoiled perforator paper tape up to 1 in. can be handled. Diameter feed hole is 0.046 in., while diameter code hole is 0.072 in., spaced 0.100 in. in both



directions. The standard stocked punch is supplied with feed holes in line with the code holes. Standard location of the feed hole is 0.394 in. from the guide edge of the tape.

Precision Specialties Inc., 1342 E. 58th St., Kansas City 10, Mo. **T-11-4**

Metal Shear and Former

Square shearing, circle shearing up to 49 in. diam inside throat and free-hand contour shearing up to 9/32 in. metal thickness can be performed on the Metlmastr sheet metal shear and forming machine. The tool permits flanging, beading, joggling, planishing, edge bending, slot cutting and louvering. It also allows inside cuts to be made without a starting hole.

Use of the tool requires only two adjustments. Operation is from a direct-

drive principle. Tooling is simple and easy to change. Cam action of the machine minimizes vibration during shearing.

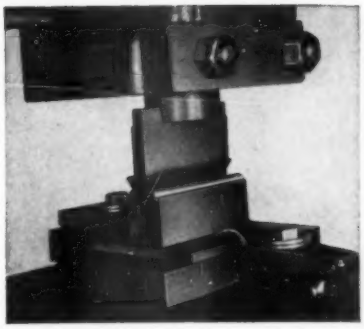
Three sizes are available: Models TE-165, TE-218 and TE-281—the numbers signifying metal thickness of maximum edge cutting capacity. Shearing capacity of the TE-165 for example is 8 ga (0.165) mild steel or 11 ga (0.120 in.) stainless steel. Cutting speeds range from 10 to 36 fpm depending on gage and material.

Lennox Tool & Machine Builders, Lima, Ohio. **T-11-5**

Press Brake Die

There is no work marking with this female press brake die with roll inserts, and die setup and change-over time are minimized. They can be used in any mechanical or hydraulic press brake or punch press.

Die block of these Di-Acro Rol-Form dies house two hardened and ground, half-round inserts which roll up and toward the opening in the die block as



the male die enters the material to be formed. Rolling action of the inserts prevent work marking. After each operation, a compression spring returns the roll inserts to a flat position ready for the next bend.

Four standard styles of the Rol-Form dies, with half-round inserts varying in size from ¼ to 1 in., are available. The larger the half-round insert, the greater the material capacity. To accommodate varying thicknesses of material in the die, the bed or ram of the press must be adjusted. This adjust-

ment also controls degree of bend. Maximum degree of bend which can be formed with the die in any one material is 60 deg.

Up to 12-ft standard lengths of the Rol-Form die can be obtained for press brakes. Shorter sections are available for punch press operations.

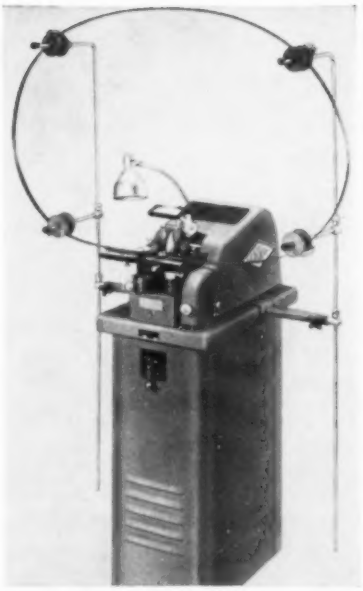
O'Neil-Irwin Mfg. Co., 625 Eighth Ave., Lake City, Minn. **T-11-6**

USE READER SERVICE CARD ON PAGE 175 TO REQUEST ADDITIONAL TOOLS OF TODAY INFORMATION

Band Saw Sharpener

An attachment for Hamco saw sharpening machines automatically sharpens band saw blades and is adaptable for sharpening circular and hack saw blades. The rack for holding the band saw blade can be extended in horizontal or vertical position, directly above the machine. Adjustable positions and arms give wide latitude of adjustment and positive holding.

By relocating the back guide bar, the guide table will accept blades from ¾ to 2 in. in width. The guide table



is adjustable by pivoting so that any desired hook may be put in the teeth. Secondary stroke adjustment on the table allows the tooth which is being ground to be fed. The feed finger tends to keep the blade back against a hardened guide bar and in proper position for grinding, to assure constant blade width throughout its length.

A spring-loaded phenolic roll pushes against the teeth so as to provide pressure against the blade and keep it against the guide bar. This, also being a phenolic, will not damage the teeth which have just been sharpened.

Hamco Machines, Inc., Dept. L, 99 Mt. Hope Ave., Rochester 20, N. Y. **T-11-7**

Air Control Valves

Single and double solenoid operated 4-way air control valves and single or double pilot (air) operated master

valves incorporate a controlled expansion seal which provides positive sealing in all operating ranges from 28-in. vacuum to 150 psig. Characteristic of the seal is its extremely low breakout friction. A balanced, direct operated spool allows use of small, low amperage solenoids for direct operating force. Short spool stroke and direct operation

TAPPING TORQUE

No, you cannot buy torque tested taps from stock today, and perhaps you never will.

But, you can get the benefit of taps whose prototypes have been torque tested for hours on end. These prototypes are the taps which tell Greenfield engineers what features of a tap have the greatest effect on cutting ability, power consumption, wearlife, and overall strength.

Greenfield's electronic torque testers also help determine the "threadability" of new materials and new alloys of old materials.

"Educated guesses" are all right in their place, but for today's requirements we'll take an electronic tape recording.

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	In any one foot		In any 6 feet	
THICKNESS	GUARANTEED	TYPICAL	GUARANTEED	TYPICAL
0.250"-1.000"	0.005	0.003	0.015	0.007
1.001"-6.000"	0.010	0.005	0.020	0.010

COSTS NO MORE. This big improvement in quality and value costs you not one penny more! Dow magnesium tooling plate STILL costs less than other lightweight tooling metals. You save money twice—once when you buy it and again when you use it.

Magnesium tooling plate is low in cost because it is rolled (not machined) to a flatness satisfactory for virtually all tooling purposes.

Next time you need a tooling metal, get in touch with one of the Dow magnesium suppliers listed below. A trial will convince you it pays to switch to magnesium. THE DOW CHEMICAL COMPANY, Magnesium Sales Department, Midland, Michigan, MA 1430A-1.

AVAILABLE FROM STOCK AT:

COPPER AND BRASS SALES, Detroit 12, Michigan
FULLERTON STEEL AND WIRE CO., Chicago, Illinois
HUBBELL METALS INC., St. Louis 3, Missouri
A. R. PURDY CO., INC., Lyndhurst, New Jersey
RELIANCE MAGNESIUM COMPANY, Los Angeles, California
VINSON STEEL AND ALUMINUM COMPANY, Dallas, Texas

YOU CAN DEPEND ON DOW

make possible complete reversal of valve position in less than one electrical cycle. All valve seats are quickly replaceable and are designed to provide floating alignment of all parts. The valves are available in ¼, ⅜, ½ and ¾-in. pipe sizes.

Air Valves Co., 22729 Hoover Rd., Warren, Mich. **T-11-8**

Metering Valves

This high pressure metering valve accurately controls fluid or gas. Outside threads give corrosion resistance and the stem may be locked at any setting. A pointer and calibration plate indicate the amount of orifice opening. A tapered throat gives a venturi tube effect with good flow characteristics.

Available in ASA or API flanged or threaded connections, the valve is made in carbon steel, stainless steel, bronze or aluminum, in sizes 1 to 6 in. and in presure ratings to 10,000 psi in all sizes.

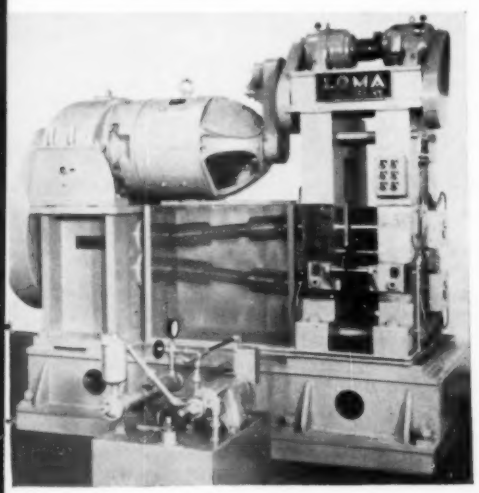
Available interchangeable tips include conical, microtip (which gives equal changes of orifice area for equal stem travel), thermo tip (which has an internal heating element in the tip), and extra hard metal tips for special abrasion resistance. Fixed diameter chokes are available in all sizes.

They can be automatically actuated by hydraulic or air pressure.

Shaffer Tool Works, 209 S. Pomona, Brea, Calif. **T-11-9**

Rolling Mill

Heavy-duty, 2-high/4-high combination rolling mill can be converted from a conventional vertical strip mill to a horizontal mill used in the compacting of metal powders into sheet and strip. The machine has extra large capacity mill housings, roll journals, universal spindles and drive transmission. The design allows the mill to take reductions of more than 50 percent per pass while maintaining tolerances as close as 5 percent of thickness.



Change-over from the 8½ x 8 in. 2-high to the 2½ and 8½ x 8 in. 4-high setup requires only 30 minutes. The 2-high arrangement is used for either hot or cold breakdown rolling of plate and sheet; grooved rolls are also available to process rounds, squares and other shapes. In the 4-high setup, strip is cold finish rolled to gages as thin as 0.002 in.

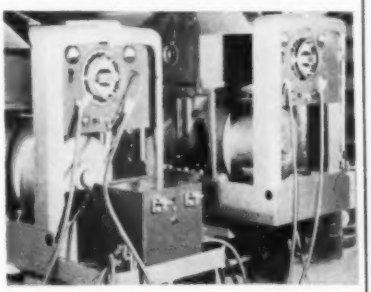
For metal powder rolling operation a special feed hopper, powder entry guide and exit chute are applied to the 8½-in. diam 2-high rolls which can produce compacted materials up to ⅛ in. thick.

Loma Machine Mfg. Co., Inc., 114 E. 32nd St., New York 16, N. Y. **T-11-10**

Attachment For Parallel Welding

Paralleling of two arc welders to utilize their combined capacity is simplified by this attachment. It also provides protection to the welders should either machine be set or adjusted improperly, or fail to perform properly.

A magnetic contactor is enclosed in

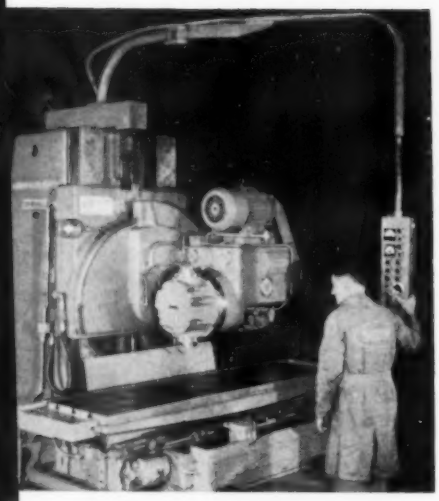


a steel case 13 in. long, 16 in. wide and 15 in. high. This is controlled by a pushbutton and by a protective current relay, with a light to indicate when the contactor closes. If the welders become badly unbalanced, current will flow in the equalizer circuit, tripping the protective relay, which trips the contactor.

Hobart Brothers Co., Troy, Ohio. **T-11-11**

Milling Machine

Rigidity of a heavy-duty milling machine is combined with range of a boring mill in the Omnimil milling machine. A 15-hp double spindle head can be adjusted to any angle to permit machining surfaces in a number of planes. The low speed spindle for ferrous material has a speed range of 25 to 400 rpm, and the high speed spindle for machining nonferrous materials has a speed range of from 250 to 4000 rpm. Both spindles have quick speed changes.



Power feed rates are infinitely adjustable between ½ and 200 ipm for longitudinal and transverse feed, and ¼ to 100 ipm for vertical feed. Accuracy in setup is provided by pendant control that permits positioning control of less than 0.001 in.

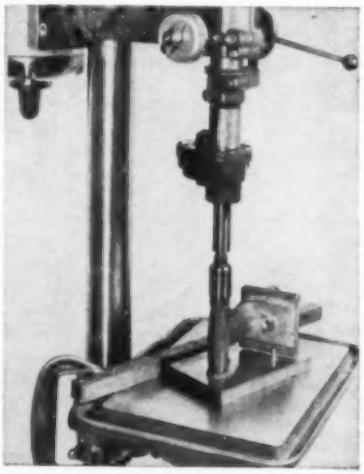
Center section of the Omnimil's head carries the motor and transmission gearing. Ninety deg circular motion that permits positioning the spindles in any angle from horizontal to vertical is power-positioned and hydraulically locked. Vernier scales provide positioning accuracy. The center section, housing the transmission, provides sufficient bulk and rigidity to absorb cutter vibration and prevent deflection during the heaviest of cuts. The front section, housing the two cutter spindles, has 360-deg manual adjustment.

The pendant is pivot mounted for operator convenience in controlling all machine functions. Because the cutter can be fed or positioned to the work, loading and unloading is always at a standard height.

Sundstrand Machine Tool Co., Rockford, Ill. **T-11-12**

Drill Press Attachment

A Slo-Speed attachment permits machine tool operations requiring slow speeds and positive drive on a 20-in. Delta drill press. It provides smooth, high torque, power transmission for common operations such as spotfacing, reaming, counterboring, core drilling,



and cutting wooden plugs. A train of double reduction gears prevents chatter and slippage.

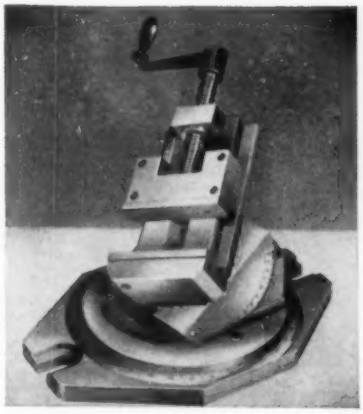
Using the 5-pulley drive of the 20-in. drill press, speed range is 70 to 1700 rpm with a 1140 rpm motor, and 105 to 2600 rpm with a 1725 rpm motor. Reduction gears of the attachment have a ration of input to output of 4.7 to 1 rpm. Spindle travel with the Slo-Speed attachment is $4^{15}/_{16}$ in.

Rockwell Mfg. Co., Delta Power Tool Div., 496 N. Lexington Ave., Pittsburgh 8, Pa. **T-11-13**

Angle Vise

The three-way Model 1A universal angle vise, which is 5¼ in. high with a 4-in. jaw capacity is suitable for compound heavy, medium, or light-duty milling, drilling, boring, grinding, etc. Wedge type movement locks assure setup rigidity up to 3000 lb torque loading. It employs a massive dovetailed cradle and cradle support, and is designed to prevent chip clogging.

All angular adjustments and locking are accomplished quickly with a single



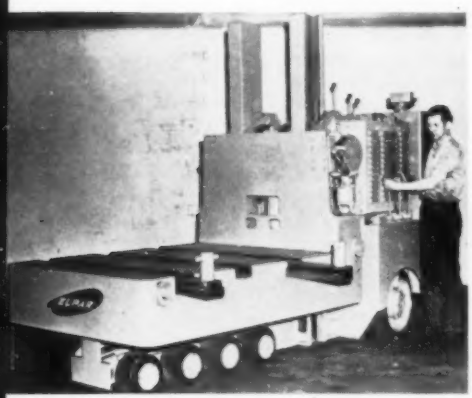
hex wrench. Graduations are accurate to ±15 minutes. Three separate angular adjustments are provided with Model 1A: 360 deg rotation of the base, 90 deg vertical range cradle adjustment and 360 deg rotation of the jaw assembly.

Wesson Co., 1220 Woodward Heights Blvd., Ferndale 20, Mich. **T-11-14**

USE READER SERVICE CARD ON PAGE 175 TO REQUEST ADDITIONAL TOOLS OF TODAY INFORMATION

Die Handling Truck

Capable of positioning dies on and off either side, or the end of its platform, this 20,000-lb capacity die-handling truck can be stationed parallel with the press in narrow aisles. The truck



has been designed to also handle Kirksite dies.

The Model E12-20 SER offers extra stability because of a single stabilizer bar which is easily pushed out from either side of the platform to be butted against the press.

Handling off the end of the truck is accomplished through tandem hydraulic operated cable winches, which can be operated separately or together for accurate positioning of the die on the

platform or into the press. Side removal is achieved through a dual set of adjustable pusher pins attached to corresponding hydraulic-operated pusher bars. The pusher pins also are designed for individual or tandem operation in positioning the die. Remote controls permit the operator to position dies accurately while standing at either side of the truck as well as in the normal drivers position.

The Elwell-Parker Electric Co., 4205 St. Clair Ave., Cleveland 3, Ohio.

T-11-15

Milling and Centering Machines

Model SMC single end milling and centering machine was developed for basic preparation of a cutoff piece or forged shaft or rod prior to turning or grinding. Milling head and center drilling head of the machine is mounted on a slide actuated by a pneumatic cylinder. Feed rate, ranging from 0 to 20 ipm, is controlled by an adjustable hydraulic check valve. Ways are automatically lubricated from the milling head. The manually actuated center drilling unit has a quill stroke of 2 in.

Capacity of the machine is ¾ to 3½-in. diam, while lengths from 4½ to 48 in. can be handled. A gage can be indexed with a flat adjustable stop for gaging from the rough end for the first milling operation, and an adjustable center for gaging the finished end for the second milling and centering operation. An adjustable support can be set for various diameters and lengths.

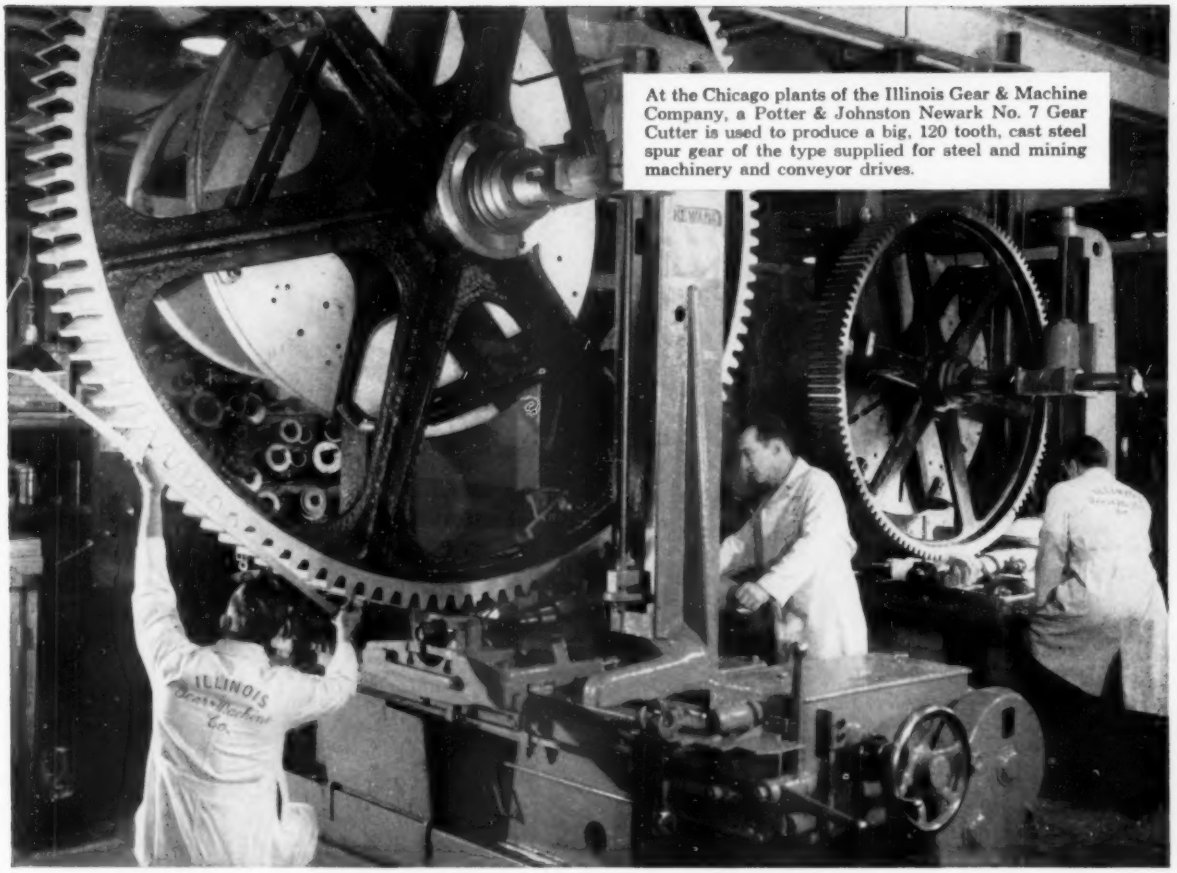
The Motch & Merryweather Machinery Co., Machine Tool Mfg. Div., 1250 E. 222nd St., Cleveland 17, Ohio.

T-11-16

Hand Grinder

Model DH-612 precision hand surface grinder is designed to minimize operator fatigue.

A 6-in. adjustment permits the operator to select best height in either standing or sitting positions. Downfeed handwheel, 12 in. out from the column is located at eye level. Each



At the Chicago plants of the Illinois Gear & Machine Company, a Potter & Johnston Newark No. 7 Gear Cutter is used to produce a big, 120 tooth, cast steel spur gear of the type supplied for steel and mining machinery and conveyor drives.

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ILLINOIS GEAR & MACHINE COMPANY USES NEWARK AUTOMATIC GEAR CUTTERS . . .

for spur gears with diameters ranging from ¾" to 126"

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. . . P&J-Newark Gear Cutters combine speed, accuracy, dependability and economy. Outstanding features include: power and rigidity for fast, heavy duty cutting; quick, easy machine setup; fully automatic operation that assures maximum output and lowest per-piece costs; and the exclusive Newark "Master Wheel" indexing mechanism, guaranteed for accuracy.

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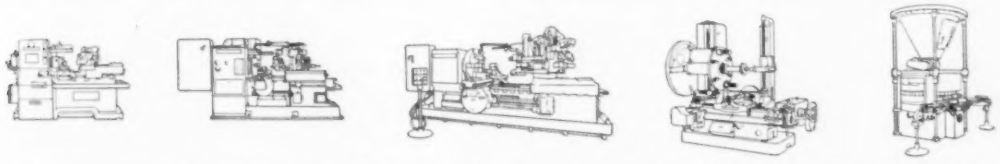
. . . and see how a P&J-Newark can bring new efficiency to your gear cutting operations. Write now for your copy of Bulletin No. 157 . . . or to arrange for one of our representatives to visit you and provide facts and recommendations. Potter & Johnston Company, Pawtucket, Rhode Island.



AUTOMATIC TURRET LATHES . . . GEAR CUTTERS . . . PACKAGING MACHINES

POTTER & JOHNSTON

SUBSIDIARY OF PRATT & WHITNEY COMPANY, INC.

PRECISION PRODUCTION TOOLING SINCE 1898

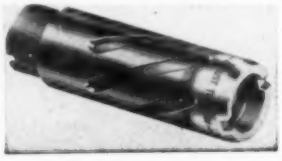
revolution of the handwheel equals 0.025 in. feed. This widens the calibrations so that "split tenth" grinding is performed easily. The crossfeed handwheel has 0.0005 in. graduations. Table feed handwheel can be located on either side of the saddle for right or left hand operation. Table feed is motivated by a timing belt drive.

The DoAll Co., Des Plaines, Ill.

T-11-17

Adjustable Pushers

To prevent loss of tension in master pushers, this adjustable tension pusher combines the use of two opposing forces: centrifugal force caused by rotation of the spindle, and spring



action of a spirally slotted outer sleeve.

Prior to inserting into the tube, the master pusher is screwed into the outer sleeve until correct tension is obtained. The threaded outer sleeve permits finger-tip tension adjustment in very small increments.

Benco Collet Mfg. Co., Cleveland 14, Ohio. **T-11-18**

USE READER SERVICE CARD ON PAGE 175 TO REQUEST ADDITIONAL TOOLS OF TODAY INFORMATION

Locknuts

High-strength, double-hex, external wrenching, self-locking nuts are designed to develop full fatigue strength of 220,000 psi bolts. The type LH3393 high-tensile nuts are from 10 to 33 percent lighter, size for size, than 180,000 psi locknuts. Further weight saving is made possible by the small envelope

dimensions since reductions of the wrench clearance requirements permit reductions in the size of other structural components.

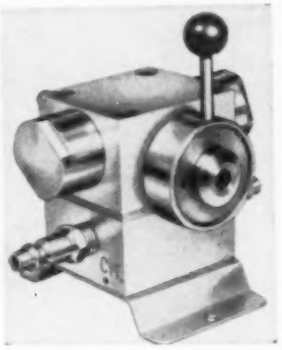
The nuts are cold formed from alloy steel, cadmium plated with a supplementary molybdenum disulphide dry film lubricant. They are available in thread sizes ¼-28, 5/16-24, 3/8-24, 7/16-20 and ½-20.

Elastic Stop Nut Corp. of America, 2330 Vauxhall Rd., Union, N. J.

T-11-19

Inching Valves

Two four-way air valves will advance the ram of a double-acting air cylinder to any desired point and stop it at that point, without creeping. For Model BL-601 (illustrated) a featherweight push moves the lever 45 deg left or 45 deg right, the full arc of its travel. One position advances the cylinder ram and the other retracts the ram but stops it instantly in the median position, trapping the air in an air cylinder and preventing further movement—even



though the air supply to the valve is disconnected.

Model BL-600 works the same as BL-601, but operates with two small limit valves rather than the lever. Depressing the button on one side moves the cylinder ram in one direction, while depressing the other button moves it in the opposite direction; the cylinder rams stops when either button is released.

Mead Specialties Co., Dept. I-74, 4114 N. Knox Ave., Chicago 41, Ill. **T-11-20**

Sensing Device

A small, air-actuated size sensing device, called the Air Capsule, is used with a CompAIRator air gage to provide high magnification visual gaging of any part requiring precise size control.

Available in both close and wide tolerance models, it may be clamped to any kind of shop gaging stand for surface plate work, or built into many specially designed inspection fixtures.

The Air Capsule, made from stainless steel, consists of a 0.375-in.-diameter body and spring-loaded plunger equipped with a 3/32 in. tungsten carbide ball contact. When the plunger contacts the work and moves into the capsule body, it restricts continuous air flow from a fixed internal nozzle, causing reduced velocity. This in turn changes pressure differential in the CompAIRator venturi chamber, causing a reading to be registered on the dial. Upper and lower product tolerance limits are set on the

Equipped with Numerical Control, this Pratt & Whitney 42" Rotary Table is bringing new standards of speed and efficiency to high-precision work involving circular spacing or angular positioning.

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PRATT & WHITNEY COMPANY, INC.
Charter Oak Blvd., West Hartford, Conn.

Please send my free copy of your Circular No. 619, describing all 16 sizes and models in the Pratt & Whitney line of Precision Rotary Tables.

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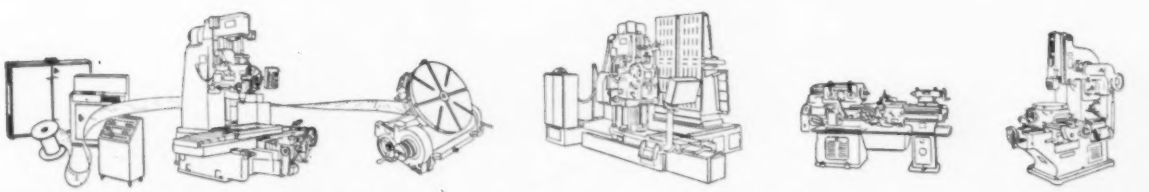
P&W Rotary Tables are built for ruggedness and stamina as well as precision. Whether you use them in conjunction with jig borers and other tools to save time and set-up in machining operations . . . or by themselves for faster, more accurate inspection, circular graduating or layout . . . P&W Rotary Tables will take continuous, heavy-duty work in stride.

Get all the facts on the 16 sizes and models of Pratt & Whitney *Precision* Rotary Tables now. See how one of these tables can bring new speed, accuracy and economy to your operations. Use the coupon above to send for your copy of our new circular, which tells you all about these precision rotary tables.

Pratt & Whitney Company, Inc.,
16 Charter Oak Blvd., West Hartford, Conn.



NUMERICAL CONTROL . . . JIG BORERS . . . ROTARY TABLES . . . KELLER MACHINES . . . LATHES . . . VERTICAL SHAPERS

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FIRST CHOICE FOR ACCURACY

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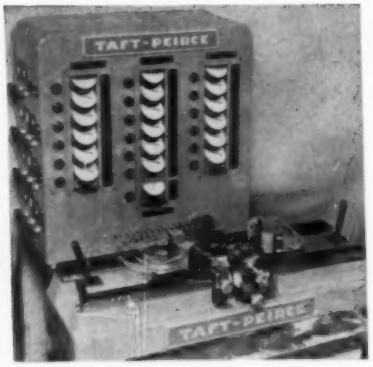
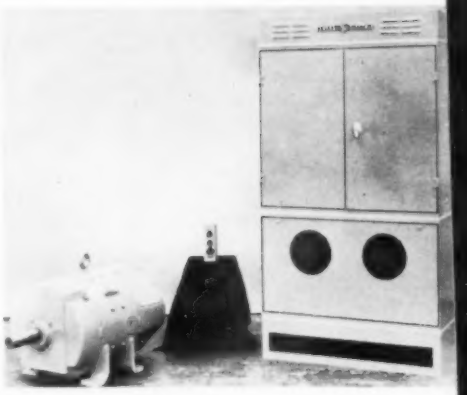


CompAIRator dial by using suitable setting masters.

The Taft-Peirce Mfg. Co., Woonsocket, R. I. **T-11-21**

Adjustable Speed Drive

A Par-matic adjustable speed drive employing power amplistat regulation is available in ratings of 10 to 200 hp. The flexible 5 percent regulated drive operates from standard 440-volt, three-phase, 60-cycle industrial power. The packaged drive consists of a compact amplistat controller, a standard d-c shunt-wound drive motor and an operator's remote control station. A static power unit provides long life and high reliability by eliminating moving parts. No warmup time is required; no foundations or other special installation measures are needed; and standard NEMA-type industrial enclosures are used. Components are completely sealed and encapsulated as protection against adverse humidity and dust conditions.



Standard units operate over a speed range of 10:1 with constant torque load. An extended range for constant horsepower is available with modifications. The drive can operate at 150 percent overload for one minute or at 250 percent overload for 10 seconds. Speed regulation of standard units is five percent no-load to full-load over the entire speed range. Full-wave operation with either timed acceleration and deceleration or current-limit acceleration provides smooth starting. Protection is provided against overload on the line. Easy front access is provided to all connections. Enclosures can be installed near a wall and several units can be aligned side by side. All drive functions are controlled from a small, portable control station which includes pushbuttons and a speed-adjusting potentiometer. A wide range of functional modications are available to provide a greater flexibility.

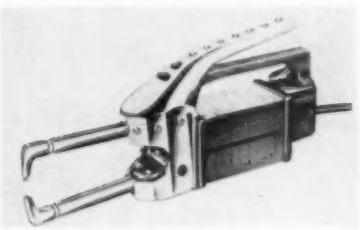
General Electric Co., Schenectady 5, N. Y. **T-11-22**

Portable Spotwelder

Fixed top tong of the Rex Junior portable spotwelder allows the operator to rest the weight of the welder on the weld area for added contact pressure. The clear throat of the unit, unobstructed by flexible lead cable, eliminates possibility of shortening the welding circuit through contact of workpiece with the cable.

The tongs may be used to weld mild steel, stainless, galvanized iron and terne plate.

Center of gravity of the 24-lb unit is



at the carrying point. Copper is used for all current-carrying parts; mechanical parts are high-strength aluminum alloy.

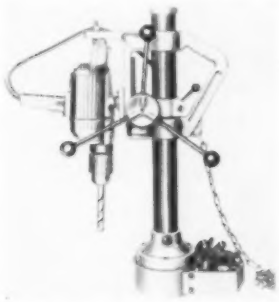
Available accessories include an automatic timer and a spring-loaded coil suspension support.

Peer, Inc., Benton Harbor, Mich. **T-11-23**

Magnetic Drill Presses

Precision electric or air drilling in remote or difficult applications is simplified with three magnetic drill presses designed to accommodate any portable air or electric drill equipped with dead handle sockets. The units can be clamped to any ferrous surface.

All three models 2MAG, 3MAG and 4MAG, have a swivel column with lock

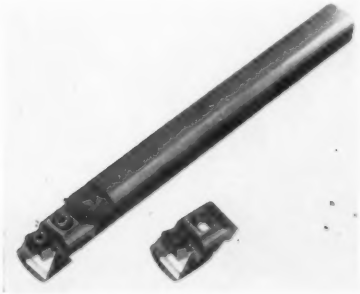


permitting accurate location of work after the magnetic press is clamped into place. Model 2MAG handles $\frac{3}{4}$-in. capacity electric and 1-in. capacity air drills and weighs 35 lb; Model 3MAG, weighing 48 lb. accommodates $1\frac{1}{4}$-in. electric and $1\frac{3}{4}$-in. air drills; the 4MAG, with 52-lb. weight, holds $1\frac{1}{4}$-in. electric and 2-in. air drills.

Thor Power Co., Aurora, Ill. **T-11-24**

Boring Bars

Boring bars with adjustable and interchangeable heads are available with either solid steel shank or steel core encased in a Kennametal sleeve. The tools incorporate seven minimum bores in a range from 1 to $2\frac{1}{2}$ in. diameter. Two sizes of offset head, each with diametral adjustment of $\frac{1}{4}$ in., are provided for the three smaller bar sizes, and three sizes of head, each with



diametral adjustment of ½ in., are provided for the four larger bar sizes. All heads accommodate Kendex throwaway triangular inserts of standard sizes and grades, and chip breakers.

Design provides a means of simple precise head adjustment, maintains high strength and rigidity, and incorporates a method of anchoring the cutting head to hold close tolerances. All heads are replaceable.

This type boring bar can be used with any chucking machine, semiautomatic lathe or other machines.

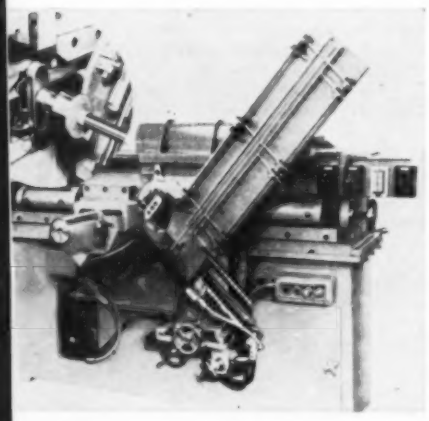
Kennametal Inc., Latrobe, Pa. **T-11-25**

USE READER SERVICE CARD ON PAGE 175 TO REQUEST ADDITIONAL TOOLS OF TODAY INFORMATION

Shell Trimmer

Engineered for high capacity, minimum tooling, small lot or production runs, Model ST-4 sliding knife drawn shell trimmer will trim up to 800 shells per hour of any shape within a 6-in. diameter, excepting those with extreme internal corners.

The sliding knife mates with a rotating universal bolster spindle holding the shell. Maximum trimming force is achieved because the rotating shell is



in constant overlap, and the sliding knife at point of contact travels at a lineal speed greater than that of the rotating shell. There is no change in direction of force, and the slicing action enables the trimming to be done with less unit force.

The ST-4 utilizes both fully automatic and single stroke cycles. When operated automatic, it loads shells from an auxiliary feeder, trims and ejects the shell, then cuts and ejects the scrap. When operated on a single-stroke cycle, two "start" buttons are contacted which in turn actuate a hold-down cylinder that seats the shell in the trimming position. The properly seated shell starts the cycle. Both hands are needed to start the machine when operated on single stroke cycle.

Template for the sliding knife is quickly made using a tool layout fixture included with each machine. All components are designed for rapid setup.

Dayton Rogers Mfg. Co., Minneapolis, Minn. **T-11-26**

End Mills

Designed for milling aluminum and aluminum alloys, these end mills have large chip clearance, and are made of special abrasion-resistant high-speed steel. The 40 deg helix and 20 deg rake design permits a shearing cut of maximum efficiency on aluminum. A com-

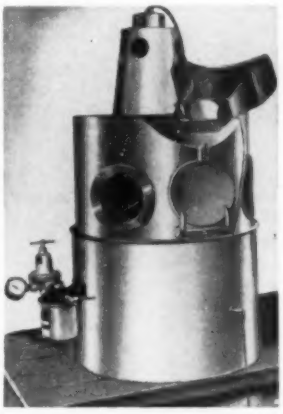
pletely ground finish over entire mill surface with ground eccentric relief of sharp precision cutting edge adds to production performance.

These end mills are available in 3 different lengths (standard, long and extra long), in sizes ¼ to 2 in.

Cutting Tool Div., Brown & Sharpe Mfg. Co., Providence 1, R. I. **T-11-27**

Wet Blast Cabinet

The "Liqui-Breez" wet blast cabinet, designed to produce high quality finish deburring, is suitable for all types of tungsten-carbide and high-speed steel cutting tools and drills. Operation of



the machine requires an abrasive load of 5 lb plus 3 lb of water.

The equipment has a self-contained bench-type cabinet, 36 in. overall height, 18 in. diameter with a working chamber 13 in. high, 18 in. diameter, and loading door 5¾ in. diameter. It includes factory installed rubber gauntlets and is operated by a foot pedal, with a viewing scope and shield to permit direct view of the work.

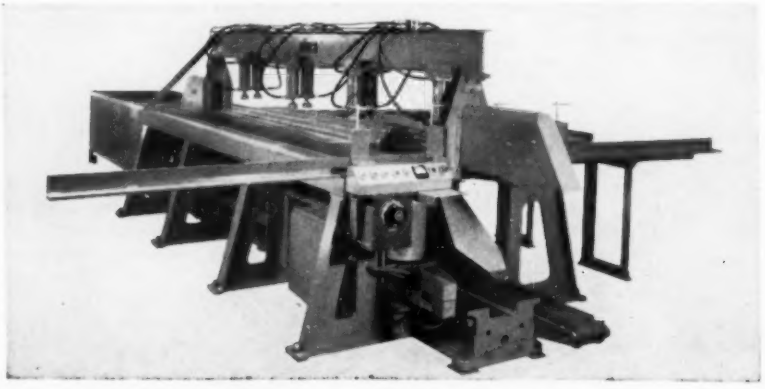
Tobin-Arp Mfg. Co., 6400 Penn Ave. S., Minneapolis 23, Minn. **T-11-28**

Plate Saw

Heavy-duty production saw for precision cutting of aluminum, bronze, copper, brass, micarta and other nonferrous metals has a heavy cast-iron bed. Entire feed motor and saw motor unit travel on a 6-ft carriage. The material to be cut is placed on cast-iron tables with the saw unit moving along the bed to cut through the material.

The machine, called No. 838 plate saw, is built in any length from 4 to 40 ft. capacity (or longer in 4 ft increments). The saw arbor measures 1½ in. in diameter to support the blade. The arbor is driven by multiple V-belts at 2200 rpm from a 20, 30 or 40 hp, 1800 rpm motor. The feed motor gives speeds from 1 to 40 fpm. The carriage returns at 40 fpm.

The tables are 30 in. wide, and are normally furnished in 4-ft and 12-ft lengths. The machine is regularly fur-



nished with table extensions measuring 18 x 48 in. Maximum length of cut made by a 12-ft machine is 12 ft, 1½ in. Maximum thickness of cut made with a 24-in. diameter saw blade is 6 in.

The machine is furnished with 5 ft fence at the front and has a saw guard, splitter and a 16-in. diameter carbide tipped saw blade.

Oliver Machinery Co., 1025 Clancy, N.E., Grand Rapids, Mich. **T-11-29**

Burnishing Tool

Surface finishes of 4 microinches and lower can be produced in a single pass with the Microller burnishing tool.

The tools, which can be used on any standard shop equipment, feed at rates of 8 to 12 ipm and finish all types of machineable metals. There are models for application to various surface geometries.

Roller action of the tool compresses and condenses the metal creating a hard

surface free of abrasive fuzz or tooth marks. Hardened rolls and mandrel tip are the only wearing parts of the tool. No adjustments are necessary after the tool has been set to size with its adjustable micrometer. This micrometer also permits sizing jobs to accuracies of 0.000025 in. and less.

Madison-Faessler Tool Co., Moberly, Mo. **T-11-30**

USE READER SERVICE CARD ON PAGE 175 TO REQUEST ADDITIONAL TOOLS OF TODAY INFORMATION

Micrometer

Sleeve of this West German made window-reading micrometer bears only graduations in 10th of an inch. The 100ths are read through a window numbered 0-9, while the 1000ths appear on the thimble, opposite the 10,000ths

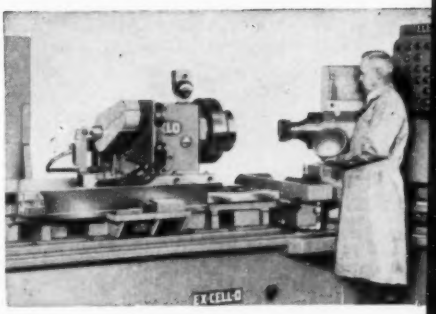
vernier, but flush with each other. Reading in the illustration thus would be: 0.3 on the sleeve, 0.07 in the window, 0.002 on the thimble, and 0.0003 on the vernier.

Flush reading for the second, third and fourth digits is free of parallax.

Opto-Metric Tools, Inc., 137 Varick St., New York 13. N. Y. **T-11-31**

Turning Machine

Rough and finish machining on the OD and the ID of wrought or forged annealed aluminum hemispheres can be performed by this custom turning machine. Diameters can range from 6 to 16 in. The work spindle permits the machine to hog out material at the rate of 15 cu in. per minute at a depth of cut of ⅛ in. A tolerance of less than 0.0001 in. on hemisphere radii and approximately 0.0001 in. total on wall



thickness is maintained on finish cuts. A surface finish of 10 rms is possible.

In one operation the slide carrying the work spindle is advanced to an end stop where it is locked in position. Repeatability of this slide motion is within 0.0001 in.; a dial gage affords visual checking of this function by the operator.

The cutter spindle plunge feeds to depth against another end stop having similar repeatability and provided with a similar checking gage.

Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich. **T-11-32**

Hardness Testing Equipment

Fully automatic hardness tester, called Twin-Tester, is capable of conducting up to 1000 tests per hour. It tests hardness of both ferrous and nonferrous metals, classifying workpieces as too hard, too soft or correct.

The combination unit is capable of taking readings in both the Rockwell and Rockwell superficial scales.

A second device is the motorized Rockwell hardness tester which is semiautomatic in operation. Known as the

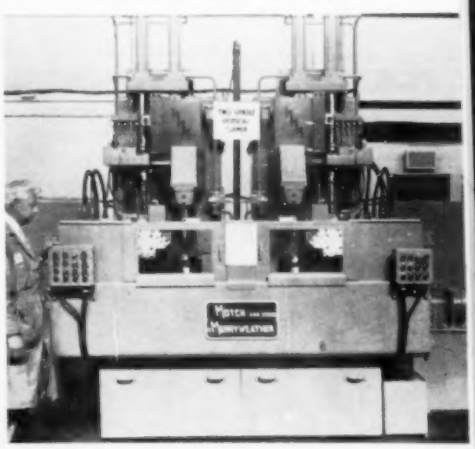
Model YR, this tester has a short test cycle in order to permit an increased number of readings to be taken and recorded within a definite time period.

Wilson Mechanical Instrument Div., American Chain & Cable Co., Inc., 230 Park Ave., New York 17, N. Y. **T-11-33**

Turning and Boring Machines

Either high or low production work as well as quick changeover jobs are done with these two and four-spindle precision vertical turning and boring machines engineered to accommodate numerous combinations of tools and slides.

Each half of the machine may be run independently of the other. Cartridge type drive spindles are mounted in



separate compartments sealed for protection. The spindles have a built-in drawbar for use with rotating air cylinder. They may be either direct or worm driven, depending upon the application. Available speeds range from 20 to 5000 rpm. Maximum stroke of the horizontal slide is 6 in. and of the vertical slide is 12 in. Hydraulic feed includes rapid traverse approach, dwell and return. Strokes are adjustable and follow in automatic sequence. Vertical

slides are provided with counterweights for smooth operation.

Both the two and four spindle machines have a separate external hydraulic system with sealed sump, pump and valves, with the system manifolded to the proper machine.

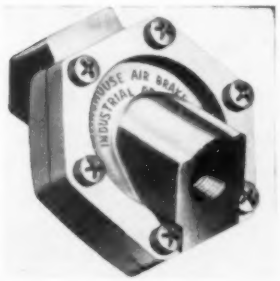
The Motch & Merryweather Machinery Co., 1250 E. 222nd St., Cleveland 17, Ohio. **T-11-34**

Quick Release Valve

Designed for fast, efficient air-pressure venting of cylinders and other pneumatic devices, this quick release valve has large internal air passages to allow it to exhaust air quickly and efficiently. Pressure can be vented in increments of approximately 6 psi.

The 7-oz valve is so constructed that it may be mounted on a rotating or revolving device and the centrifugal force will not impair its operation.

Supply port may be assembled on the



valve so that inlet and outlet ports are mounted either on the same center line or at right angles to each other.

Aluminum construction assures corrosion resistance and minimum maintenance. The oil-resistant diaphragm is the only wearing part.

Westinghouse Air Brake Co., Industrial Products Div., Wilmerding, Pa. **T-11-35**

Gear Checking Machine

The Mahr 890 machine combines accuracy with short inspection time for checking involute tooth flank profiles on internal and external spur and helical gears, bevel gears and worm gears.

An infinitely adjustable optical base circle setting is provided for gear diameters between 0 and 20 in. There is no need for base circle disks. A highly sensitive, shock-proof stylus and a recording magnification of 500 and 1000X assures accuracy. Roll ratios are adjustable to 1:1, 2:1 and 4:1. The machine checks bevel gears by means of a holding device. This unit can be swung through 105 deg and is set with slip gage blocks. For inspection of internal gears an offset stylus is used.

Gears to be inspected are held either on arbors or between centers to a

maximum distance of 16 in. The driver is adjustable to any shaft diameter. Pitches from DP 1½ to DP 50 can be inspected with a standard set of gaging points.

Surface finish of tooth flanks can also be checked and recorded easily with a knife-edge gaging point.

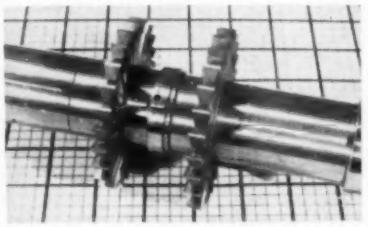
Cosa Corp., 405 Lexington Ave., New York 17, N. Y. **T-11-36**

USE READER SERVICE CARD ON PAGE 175 TO REQUEST ADDITIONAL TOOLS OF TODAY INFORMATION

Spacing Collars

Micrometer adjustable spacing collars for milling machine cutter arbors assure accurate spacing of all side milling cutters, gang cutters, gang milling and various other types of multiple setups on any type of milling machine equipment.

When it is necesary to sharpen and



grind the cutters, the adjustable collar readily compensates for variation in side milling cutter sharpening, particularly in all straddle milling operations.

Callibration is in thousandths. Smaller dimensions can be accurately callibrated.

Dayton Rogers Mfg. Co., 2824 Thirteenth Ave., South, Minneapolis 7, Minn. **T-11-37**

good READING

LOGICAL DESIGN OF DIGITAL COMPUTERS —*By Montgomery Phister, Jr. Published by John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N. Y. Price $10.50. 408 pages.*

Expanded use of digital computers for machine tools for control has increased the need for engineers to understand the fundamentals of computer systems. Introductory in level, this book concentrates on the practical application of techniques needed to design digital systems using the logical-equation method.

Since much of the mathematical requirements in computer design is based on Boolean algebra, an entire chapter is devoted to the development of this subject. In addition, all the important Boolean simplifications are compared, including the Quine and Harvard methods as well as the Veitch diagram simplification procedure.

Equipment for input-output functions is described by use of simplified sketches of the units and text based on the assumption that the student has not been exposed to the subject previously. The book may be used as a text for a course in digital computer design.

ESTIMATING MACHINING COSTS—*By C. W. S. Parsons. Published by McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York 18, N. Y. Price $8.00. 370 pages.*

Estimating is the basis of most preliminary cost determination in manufacturing plants. To assist the estimator in the correct determination of costs for machine tool operations, this book is planned to show how to study the engineering drawing of a workpiece to determine how the part should be made.

In the breakdown analysis of the needed operations and their elemental subdivisions, the various factors contributing to the completion of the workpiece are given in time and money values. Relationships between men, ma-

terials, tooling and machines are also given extensive treatment.

An analysis of the characteristics necessary to make a good estimator is discussed to show the technical and personal background requirements. Other fundamentals covered in relation to cost estimating and engineering are such basic factors as tool life, machinability and cutting tool materials. Detailed estimating problems on the various machine tool operations help to present the estimating fundamentals.

RADIOISOTOPES A NEW TOOL FOR INDUSTRY—*By Sidney Jefferson. Published by Philosophical Library, Inc., 15 E. Fortieth St., New York 16, N. Y. Price $4.75. 110 pages.*

Many industrial uses have been found for the radioisotopes and more are found each day. This book explains the fundamentals of the systems for the use of radioactive materials in current use. Included are applications as markers, leak detection, thickness measurement, level and density gages and radiography.

In the section on the elementary fundamentals of radioactivity, atomic structure is discussed as well as the formation of isotopes, particles and the nuclear changes resulting from exposure to high energy particles. Other items covered are atomic energy and atomic piles, transmission and detection of radiations and health precautions required when using these materials.

TURNING: TOOLS, METHODS, COST—*By Walter G. Holmes, member ASTE. Published by Reed Technical Service, 10054 Holmur, Detroit 4, Michigan. Price $7.50. 241 pages.*

This book is a compilation of the many facets of manufacturing that make up the turning process. An analysis of the various materials, tool types, tool elements as well as tool cost study is included.

The first section of the book covers machinability, symbols of the various materials and recommended feeds and speeds for the various classes of machining services. These classes include light duty turning, medium duty chucking, heavy duty turning and high velocity turning applications.

Tool types cover the various single point turning tools used for boring, turning and thread chasing. In the last section, costs and controls for the jobbing and mass production operations are covered from the view of the components that make up the ultimate piece price as well as the allowances for the replacement of existing equipment.

THE TOOL ENGINEER'S *Service Bureau*

TRADE LITERATURE CURRENTLY OFFERED BY THE TOOL ENGINEER ADVERTISERS

A-11-171-1—Scroll Chucks—*Alina Corp.* Literature and complete catalog available on all sizes of scroll chucks. (Page 171)

A-11-65—Brass—*The American Brass Co.* Publication B-39 gives complete detailed information on Formbrite super-fine-grain drawing brass. (Page 65)

A-11-29—Drill Bushings—*American Drill Bushing Co.* Literature describes complete line of drill bushings. (Page 29)

A-11-4—Radial Drill—*The American Tool Works Co.* Bulletin No. 325 gives facts on "American" hole wizard radial drills. (Page 4)

A-11-189—Hack Saws. *Armstrong-Blum Mfg. Co.* Marvel bulletin is complete with information on Marvel metal-cutting saws. (Page 189)

A-11-199—Vibratory Feeders—*Peeco Div. Automation Devices, Inc.* Literature on vibratory parts feeders and name of nearest representative available. (Page 199)

A-11-184—Drilling and Tapping Machines—*Baker Brothers, Inc.* New catalog describes new line of hydraulic vertical and horizontal drilling and tapping machines. (Page 184)

A-11-242—Carbide Pushers—*Balas Collet Mfg. Co.* Descriptive literature and prices available on Balas adjustable tension master pushers equipped with Balas solid carbide pusher pads for automatic screw machines. (Page 242)

A-11-226-1—Drilling Units—*Bedford Gear and Machine Products, Inc.* Free catalog and data sheets available on hydroscope automatic drilling unit. (Page 226)

A-11-217—Air Drill Head—*The Bellows Co.* Bulletin BL-22 gives details on Bellows Locke Model 22A drill head. (Page 217)

A-11-195—Optical Index Table—*Bentley Industrial Corp.* Illustrated brochure shows new O.M.T. 12" and 16" fully optical rotary and inclinable table. (Page 195)

A-11-10—Surface Grinders—*The Blanchard Machine Co.* Model 18-C folder available on Blanchard No. 18-C surface grinder. (Page 10)

A-11-192—Cutting Tools—*Brown & Sharpe Mfg. Co., Cutting Tool Div.* New Nelco catalog describes complete line of carbide cutting tools. (Page 192)

A-11-15—Height Gage—*Cadillac Gage Co.* Complete information on Cadillac Pla-Chek gage line now available. (Page 15)

A-11-206-2—Fixture Components—*Carr-Lane Mfg. Co.* Complete line of jig and fixture components described in Catalog 5. (Page 206)

A-11-234-1—Low-temperature Melting Alloy—*Cerro de Pasco Sales Corp.* Bulletin G6 gives engineering information on Cerro base alloys. (Page 234)

A-11-172—Optical Grinder—*Cleveland Grinding Machine Co.* Free brochure describes the capabilities of the visual grinding machine for contour precision grinding. (Page 172)

A-11-207—Turning Machines—*Cleveland Hobbing & Machine Co.* Modular machine technical bulletin No. 204 gives engineering data and specifications on Cleveland turning machines. (Page 207)

A-11-173—Tool and Die Making—*Cleveland Tool and Die Co.* Free brochure describes facilities of Cleveland Tool and Die Co. (Page 173)

A-11-196—Carbide Gages—*Arthur A. Crafts Co., Inc.* Eight-page carbide gage catalog describes new Craft's gages. (Page 196)

A-11-53—Lapping Machine—*Crane Packing Co.* Free booklets contain facts on producing and measuring precision flatness and finish. (Page 53)

A-11-210—Hydraulic Press—*Denison Engineering Div. American Brake Shoe Co.* Bulletin M-34 gives information on new "E" series Multipress line. Page 210)

A-11-171-2—Die Head—*The Eastern Machine Screw Corp.* "Unified and American Screw Thread Digest" sent free on request. (Page 171)

A-11-205—Projectors—*Eastman Kodak Co.* Illustrated booklet "Kodak Contour Projector" gives details on production uses of projection equipment. (Page 205)

A-11-161—High-Speed Cameras—*Eastman Kodak Co.* Complete details on high-speed motion pictures available in new booklet "High-Speed Motion Pictures at the Service of the Engineer." (Page 161)

A-11-185—End Mills—*Eclipse Counterbore Co.* End mills described in Catalog E—58 M. (Page 185)

A-11-156—Milling Machines—*Famco Machine Co.* Catalog shows complete information on Famco milling machines. (Page 156)

A-11-16—High-Speed Steel—*Fifth Sterling Inc.* Descriptive bulletin TBI-57 gives information on high-speed tool bits and Circle C throw-away inserts. (Page 16)

A-11-62—Broaching Machines—*The Foote-Burt Co.* Circulars No. 503 and 509 describe Foote-Burt surface broaching machines. (Page 62)

A-11-151—Cathetometer—*The Gaertner Scientific Corp.* Bulletins 188-53 and 194-57 contain complete information on Gaertner coordinate cathetometers. (Page 151)

A-11-31—Cutting Oils—*Gulf Oil Corp.* Illustrated bulletin available on Gulfcut Heavy-Duty soluble oil. (Page 30-31)

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A-11-27—Hydraulic Cylinder—*Hanna Engineering Works.* Full details on Hanna hydraulic cylinder line available in Catalog 900. (Page 27)

A-11-180—Gages—*Hanson-Whitney Co. Div. of Whitney Chain Co.* Catalogs available describing complete line of Hanson-Whitney thread gages. (Page 180)

A-11-223—Lathes—*Barber-Colman Co., Hendey Machine Division.* New 16-page catalog shows the new Barber-Colman 36-speed lathe pays for itself. (Page 223)

A-11-52—Milling Cutters—*Cutter Div., The Ingersoll Milling Machine Co.* New book tells about the services of the cutter division and illustrates inserted blade cutters. (Page 52)

A-11-212-2—Drawing Equipment—*Mayline Co.* The complete line of Mayline equipment described in Catalog 9-A. (Page 212)

A-11-54—Carbide Tools—*Metal Carbides Corp.* Complete line of Talide carbides described in 76-page Catalog 56-G. (Page 54)

A-11-230-2—Drill Bushings—*W. F. Meyers Co., Inc.* Information and price list on Meyco carbide inserted drill jig bushings shown in Catalog N. 42. (Page 230)

A-11-211—Subland Drills—*Mohawk Tools, Inc.* Twelve-page catalog illustrates the multiple advantages of drilling and chamfering with subland drills. (Page 211)

A-11-220-4—Tools—*Montgomery & Co., Inc.* 1958 catalog contains 92 time savers for toolmakers. (Page 220)

A-11-166—Jig Boring Book—*Moore Special Tool Co., Inc.*, "Holes, Contours and Surfaces" book containing 424 pages available for $5 in USA. (Page 166)

A-11-237-1—Jig and Fixture Components—*Northwestern.* Catalog of complete line of jig and fixture components and tracing templates now available. (Page 237)

A-11-36—Cleaning Compounds—*Oakite Products, Inc.* Sixteen-page illustrated booklet "Cleaning and Preparing Metal in Aircraft Production" now available. (Page 36)

A-11-43—Hydraulic Cylinders—*Ortman-Miller Machine Co.* Bulletins 107 and 108 describe O-M automation heavy-duty air and hydraulic cylinders. (Page 43)

A-11-24—Bending Machines—*Pines Engineering Co., Inc.* Free case studies reports on cost-cutting advantages of cold forming available in copes of Pines News. (Page 24)

A-11-9—Spindle Repair and Rebuilding Service—*Pope Machinery Corp.* Bulletin R-2 describes the how and why of spindle repair and rebuilding. (Page 9)

A-11-187—Thread Rolling Attachment—*Reed Rolled Thread Die Co.* Helpful information on thread and form rolling described in copy of Thread Rolling Attachment Bulletin B-2. (Page 187)

A-11-162—Clutches—*Rockford Clutch Div. Borg-Warner.* Bulletin shows typical installations and applications of Rockford clutches and power take-offs. (Page 162)

A-11-181—Tool Control System—*Seibert & Sons, Inc.* Complete data on new control system in Circular B-10. (Page 181)

A-11-178—Chucks—*Speedgrip Chuck, Div. of Ernest, Holdeman & Collet, Inc.* Bulletin No. 23 gives full information and description on Speedgrip 'Cyl-Chuck." (Page 178)

A-11-190-1—Tumble Jigs—*Standard Parts Co.* Free Tumble-jig bulletin describes details of new "Tumble" box jig. (Page 190)

A-11-42—Socket Screws—*Standard Pressed Steel Co.* Fastener reliability information and copy of new SPS booklet "High Reliability." (Page 42)

A-11-2—Micrometers—*The L. S. Starrett Co.* Catalog No. 27 illustrates complete line of Starrett micrometers. (Page 2)

A-11-61—Form Grinding—*The Thompson Grinder Co.* Catalog T-558 describes engineering experiences with Thompson truforming operation. (Page 61)

A-11-56—Adjustable Drill Heads—*United States Drill Head Co.* Catalog AD-57 gives complete information on standard sizes of U S drill heads. (Page 56)

A-11-234-3—Tube End Forming—*The Vaill Engineering Co.* New Bulletin T-1 shows the versatility of Vaill tube end forming machine. (Page 234)

A-11-38—Tooling Specialties—*Vlier Engineering Corp.* New catalog shows complete line of Vlier products. (Page 38)

A-11-227—Retaining Ring—*Waldes Kohinoor, Inc.* Information and engineering data on Truare Prong-Lock ring, Series 5139, available in new literature. (Page 227)

A-11-212-1—Cut-Machining—*Wallace Supplies Mfg. Co.* Free 44-page book gives complete information on Wallace cut-machining. (Page 212)

A-11-230-3—Bending Machines—*Wallace Supplies Mfg. Co.* Thirty-six-page book gives information on various benders with inplant pictures. (Page 230)

A-11-155—Collet Fixtures—*Zagar, Inc.* Engineering Data Sheets "E-11" give complete information on Zagar collet fixtures. (Page 155)

A-11-48—Microscopes—*Carl Zeiss, Inc.* Free booklet gives information on Carl Zeiss universal measuring microscope. (Page 48)

A-11-237-2—Toolholder—*W. M. Ziegler Tool Co.* Catalog describes the Ziegler Floating toolholder. (Page 237)

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Field Notes

Diamond Alkali Co. has revealed plans to build a multi-million dollar campus style research center near Painesville, Ohio. The new facility, which will supplement present scientific facilities in Fairport, will be constructed in stages. Initial phase, to cost from $2- to $3-million, will include the central research building and the development building. The one will provide suitable space for 60 laboratories, 22 offices, library, patent department and other supporting services. The other will house a pilot area providing an open section for experimental operation. Second phase of the project will represent an extension of the first units plus additional buildings to meet expanded research requirements.

expansions

An extension of the present building of PIC Design Corp., subsidiary of Benrus Watch Co., Inc., was recently completed. The additional quarters provide another 10,000 sq ft for the company's expansion program and will allow integrated departments for engineering, research and development, assembly, sales and administrative branches.

v v v

A 60-percent increase in floor space for manufacturing numerical control systems is being provided by the plant expansion under way for Bendix Industrial Controls Section of Bendix Aviation Corp. The new facility will be located next to the company's main plant.

v v v

A $300,000 addition has been completed for Miniature Precision Bearings, Inc. to provide a 50-percent increase in manufacturing space. The 25,000-sq ft section is reported to afford the added production area to make it possible for MPB to offer 30-day delivery lead time on bearing orders.

v v v

As part of an expansion program that has doubled its facilities, Edson Tool & Mfg. Co. installed two 500-ton hydraulic presses designed for precision deep drawing and other metalworking operations. They are part of a battery of presses capable of working strip, sheet and plate blanks up to 48 x 120 in. and from 1/64 to 1/2 in. thick. Other new facilities include ten press brakes, three power shears, ten spot welders and new machining equipment. A new addition has doubled the plant area.

new activities

Development, manufacture and sale of chemicals used in die casting and metalworking industries will be the responsibility of a newly formed division of American Charcoal Co. called the Chemical Products Div. The parent firm expects the step to afford greater concentration on research and product development.

v v v

Special research, engineering and production skills and facilities of The Electric Auto-Lite Co.'s General Products Group are being expanded through a program which coordinates the 19 Auto-Lite engineering laboratories for "project" research and development to expedite solutions to customer cost and performance requirements. Initial contact for the new service will be made by an increased General Products Group sales force, and experts will coordinate follow-through engineering and production coordination in each of the group's product areas.

v v v

Aimed toward intensifying use of aluminum forgings for hand tools, Harvey Aluminum has inaugurated a product development program primarily for industrial designer, design engineer and materials specifier. The project furnishes manufacturers with application studies and metallurgical data. First phase of the program concerns press forged handles for spray guns, drills, power hammers and other implements.

trade associations

Up-to-date information on design, construction, application and testing of expansion joints for piping and other services has been gathered into a recently published manual "Standards of the Expansion Joint Manufacturers Association." Much of the information in the book, compiled by the association's technical committee, is previously unpublished information, which will serve as useful reference.

v v v

The Small Lot Stamping Institute has compiled a 14-page manual of suggestions for design specifications intended to help standardize short run stamping requirements. The manual,

---

Latest developments in jig boring and jig grinding equipment recently installed at Size Control Co. can provide tolerances as close as 0.00005 in. on gages, piece parts and fixtures. The facilities have been designed into working areas with each machine mounted on concrete piers four ft thick and isolated from vibration. Special electronic gages are used to check accuracies that later are certified by The Midwest Gage Laboratory as to tolerances and dimensions. According to E. E. Olds, sales manager for the company, the jig boring and jig grinding services can guarantee accuracies in piece parts to 0.0001 in. under normal conditions and as close as 0.00005 in. in special situations. Such accuracies are available in small lot quantities for research and development work and prototype operations.

directed primarily to engineers and purchasing agents, covers quantities, materials, tolerances, clearances, blank design, piercing and bending. It is available from company members of the institute or from its headquarters, 2525 Park Ave., Minneapolis 4, Minn.

V V V

National Machine Tool Builders' Association has printed a booklet describing 147 motion picture films released by member companies on machine tools and machining operations. The films, 84 of which are in color, range from 5 to 70 minutes for showing time. Many have been prepared for sales or training purposes and are concerned with specific machining operations; others are institutional types discussing the part tools play in achieving higher standards of living.

V V V

American Institute of Industrial Engineers has published a series of abstracts of research performed in the field of industrial engineering. Ultimate objective of the institute's Research Information Committee is complete compilation of all industrial engineering research work. The committee is beginning a second survey concerning research completed between July 1, 1947 and July 1, 1952. In line with this work, the committee is welcoming research abstracts of work performed during this period. At the same time, organizations which did not fully complete listing of their research for the period of July 1, 1952 to July 1, 1957, have been invited to include their abstracts in the second survey.

new facilities

Production is now under way in the recently completed 80,000 sq ft plant for H. K. Porter Co. (Canada) Ltd. in Acton, Ontario. It will provide permanent headquarters for both Disston Div., located until recently in Toronto, and for the new Refracteries Div. which was located in Guelph. The facility marks the second stage in an expansion program for the company.

V V V

Equipment and facilities for relapping granite surface plates up to 3 x 4 ft have been installed at the Herman Stone Co. in Dayton, Ohio, to supplement the factory in Mt. Airy, N.C. where all relapping previously was done. The new facilities are temperature and humidity controlled around the clock to insure accurate measuring standards.

acquisitions

Business and assets of Industrial Gauges Corp. have been acquired for cash by Daystrom, Inc. The transaction also included related patents owned by Charles B. Zimmer, founder and president of Industrial Gauges. The newly acquired firm will become the Industrial Gauges Dept. of Daystrom-Weston Industrial Div. Mr. Zimmer and other present management will join the Daystrom organization.

V V V

With the acquisition of another motor line, Howard Industries, Inc. has completed purchase of Induction Motors from Westinghouse Electric Corp. of Lima, Ohio. Equipment is being moved to the Howard Racine plant.

V V V

S. C. Johnson & Son Inc. has acquired patent rights of Porelon with the purchase of the Perma Stamp Corp. This is another step in Johnson's diversification program.

V V V

Most of the assets formerly used by the Industrial Furnace Div. of Westinghouse Electric Corp. have been acquired by Sunbeam Equipment Corp., a newly formed subsidiary of Sunbeam

Corp. The property included design and engineering files, equipment and production facilities occupying a nine-acre plot in Meadville, Pa. The operation includes a line of industrial furnaces for production processing, designed for all types of fuels. Sunbeam will produce similar type equipment and manufacture service and replacement parts for equipment previously produced in Meadville.

V V V

Diebel Hi-Speed automatic presses have been acquired from Di Machine Corp. by Havir Mfg. Co. which will add them to the line of Pressrite O.B.I. presses made by the company. All manufacturing will be done in Havir's St. Paul plant.

V V V

Lindberg Industrial Corp. recently acquired Continental Industrial Engineers. Key personnel are moving to the Lindberg Industrial plant but will continue to operate as a separate division. William Darrah, formerly president of Continental Industrial, became vice-president of the newly created Continental Div.

V V V

All outstanding capital shares of a machine tool firm in Goeppingen, Wuerttemberg, Germany have been acquired by Ex-Cell-O Corp. The German firm, Werkzeugmaschinenfabrik Goeppingen G.m.b.H., will operate as an independent subsidiary. It makes a line of lathes, medium size planers and textile looms. An 11-acre site has been purchased in the adjoining city of Eislingen for erection of a new manufacturing plant and office building. The new facility will allow the German firm to manufacture both its own line of products and those of Ex-Cell-O and its other subsidiaries.

moves

Universal-Cyclops Steel Corp. opened a specialty steel service center at 15 Sagamore Rd. in Worcester, Mass. It will provide more than three times the floor area of the company's previous location on Ward St.

V V V

To improve its New York export facilities and provide larger quarters for its factory branch, Binks Mfg. Co. has moved to new facilities at 35-42 Forty-first St., Long Island City. Most of the area will be used for warehouse and service, and the remaining for offices.

V V V

New housing for The Cleveland Instrument Co. has been completed at 6220 E. Schaaf Rd. in Cleveland. The

one-story structure, located in an area readily accessable to the Freeway and metropolitan Cleveland, will provide expanded space for the growing operation.

v v v

Nu-Tool Sales Co. has moved to new offices at 17227 W. McNichols in Detroit. The company, which serves as a representative in Michigan for various manufacturers, also offers saw resegmenting and sharpening service for saw users in the area.

v v v

Avco's Research and Advanced Development Div. has moved to a new center at 201 Lowell St. in Wilmington, Mass.

corporate changes

Plans were announced by Cleaver-Brooks Co. to establish its Special Products Div. as a separate corporation. The new firm will be named Cleaver-Brooks Special Products, Inc. Reason given for the corporate change is the company will be able to achieve a higher concentration on the part of management for its sales and production problems.

name changes

To more accurately reflect the wide variety of its industrial products, National Forge & Ordnance Co.'s name has been changed to National Forge Co. While the company is continuing to produce ordnance material, it constitutes a relatively small percentage of production.

v v v

Name of the company formerly known as C. B. Hunt & Son, Inc. has been changed to Hunt Valve Co. so that its name will be more closely identified with the products manufactured.

new offices

Zagar, Inc. has opened a district office at 7114 Rising Sun Ave. in Philadelphia. Harry Hutter was named manager of the office.

v v v

Ohio Valley Div., Inc., a warehouse-service center to serve Columbus area industry, has been established by Eutectic Welding Alloys at 206 W. Mound St. in Columbus, Ohio.

v v v

Open house marked the formal opening of the Pacific Div. of Titeflex, Inc. in Santa Monica, Calif. The 15,000-sq ft building houses manufacturing, assembly, engineering and warehouse facilities as well as the Los Angeles district sales office.

technical shorts

Scientists Develop Instrument for Magnetic Studies

To meet problems in acquiring fundamental data on new magnetic materials, Westinghouse Electric scientists recently designed and built a remote controlled "torque magnetometer." The instrument is used to measure and record torque exerted on a thin disk of magnetic material suspended in the gap of an electromagnet. The studies are being made to determine effects of radiation on magnetic properties of materials. As the sample of material is rotated, the torque exerted on the disk changes according to the change in magnetization of the material. This is measured by the torque magnetometer and automatically plotted on a strip chart recorder. Result is a curve of torque versus angular position of the disk, with respect to the direction of the applied field. The information can then be used to determine the ease with which a material can be magnetized in a certain direction.

* * *

Test Method Finds Zinc On Stainless

An analytical method to detect zinc on the surface of stainless steel sheets is solving a damaging fabrication problem. Metal fabricators have frequently found that zinc particles from certain types of forming dies are left on a stainless surface and the material is welded without removing the particles. Welding heat causes the zinc to penetrate into grain boundaries of stainless, causing it to crack.

The new test, developed by Research Laboratories of Armco Steel Corp., provides surface of stainless sheets. The technique is based on the reddish purple color resulting from reaction of zinc with dithizone in alkaline solution.

Interferences are cadmium and copper, which produce somewhat similar colors, violet for cadmium and purple for copper. Yet these may readily be distinguished from zinc by comparing with certain standards.

Test method uses 0.02 g of dithizone (diphenyl thiocarbazone - Eastman No. 3092) dissolved in 100 ml of 10 percent NaOH solution. It should be prepared fresh daily. Test paper can be any grade of acid-washed filter paper.

Comparison standards are prepared by marking "x's" on the surface of a stainless sheet with samples of essentially pure zinc, cadmium, and copper metals. A piece of filter paper then is dipped in a beaker containing the dithizone solution, drained for a moment, and layed on the marked surface of the standard. In a few seconds each of the metals will produce a colored "x" on the paper—reddish purple for zinc, violet for cadmium, and purple for copper. The unknown deposit on the surface of the material on which zinc contamination is suspected is compared with the standard.

A piece of filter paper dipped in the dithizone solution etc. as when preparing the standard then is placed on the surface suspected of contamination. Comparison of the resultant tell-take color will settle the question.

Correction: The September issue of The Tool Engineer announced the newly developed Grade 8 alloy by Ampco Metal, Inc. Unfortunately an allowable working stress of 70,000 psi was attributed to the alloy. The working stress is 10,000 psi.

Greenlee Transfer Machines can be Reworked to meet Product Changes

The Greenlee "Rearrangeable Unit" concept of transfer machine design is becoming increasingly popular in mass production manufacturing. These machines accommodate recurring changes in product design. Year after year they guard against costly obsolescence . . . they are changed to meet your changing requirements. Get the complete story from Greenlee.

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Men at Work

Clarence O. Lorig (left) became president of American Society for Metals at the society's recent congress in Cleveland. Dr. Lorig is technical director of Battelle Memorial Institute.
Russell M. Fellows (right), vice-president and treasurer of The Fellows Gear Shaper Co., has been elected chairman of the board.

New officers elected by American Society for Metals to serve for the coming year with new president Clarence O. Lorig are WALTER CRAFTS as vice-president and WALTER D. JOMINY as secretary. Mr. Crafts is associate director of research of Metals Research Laboratories at Electro Metallurgical Co., and Mr. Jominy is retired chief metallurgist and now consultant for research at Chrysler Corp. ROBERT H. ABORN was reelected treasurer of the society. Dr. Aborn is with E. C. Bain Laboratory for fundamental research at U. S. Steel Corp.

Three principal officers were elected by the board of directors of The Laminated Shim Co., Inc. EDWARD B. NISBET, formerly president, became chairman of the board, while A. V. ANDERSON stepped up from executive vice-president to succeed him and to assume the post of general manager. MERLE L. LOCKWOOD, who had been vice-president in charge of sales, was advanced to executive vice-president and director of sales.

Eclipse Air Brush Co. has announced promotion of JAMES L. WHALEN to vice-president and sales manager. Associated with Eclipse for more than 11 years, he has been sales manager since December of 1954.

The Hicks Corp. has made public the appointment of FRANK T. MAJEWSKI as executive vice-president, and JOHN O. WAGNER as sales manager. Both men previously were associated with The M. W. Kellogg Co. where Mr. Majewski was manager of the Rocket Div. and Mr. Wagner was sales manager.

The Cincinnati Milling Machine Co. has named ALBERT H. DALL chief engineer of the Machine Tool Div. Since becoming associated with the firm in 1925 he has served in various capacities in the engineering and research departments. He will coordinate engineering activities of the Milling Machine, Grinding Machine, Electro-Hydraulics and Special Machine Tool Divs. He also is responsible for the Development Research Laboratory.

Promotion of C. A. LESSING to chief engineer in charge of new product development was announced by Copeland Refrigeration Corp. following separation of new product development and standard product engineering. Don Fry continues as chief engineer of standard products.

Pratt & Whitney Co., Inc. has named ALBERT M. DEXTER director of metrology. In this capacity he will direct all activities having to do with science of measurement in the gage division company's and also will be responsible for quality control and conventional gage inspection.

Members of the Instrument Society of America meeting at the annual conference and exhibit elected HENRY C. FROST president for the coming year. New president-elect-secretary is JOHN JOHNSTON, JR. Mr. Frost is assistant chief engineer of Corn Products Refining Co. while Mr. Johnston is supervisor of E. I. duPont de Nemours' Engineering Service Div.'s consultation group.

RAY P. DUNN was named technical director of Lindberg Melting Furnace Div. of Lindberg Engineering Co. and will be in charge of technical development of the company's line of furnaces. Mr. Dunn previously was director of metallurgy for U. S. Reduction Co.

JOHN D. MACKENZIE was elected chairman of the board of American Smelting and Refining Co. to succeed the late Kenneth C. Brownell. He also will continue as president of the company.

Appointments of two executives at Union Spring Mfg. Co. involved ERIC ECKBERG, now vice-president in charge of sales, and CORNELIUS A. RAUH, who became sales manager of the subsidiary, Biggs Steel Foundry & Fabricating Co.

EUSTACE LINGLE was appointed vice-president in charge of industrial sales and education for Oakite Products, Inc. He has been associated with Oakite since 1929 and has been a director since 1939 and a vice-president since 1953.

Oakite also announced appointment of GEORGE M. SEIB, formerly company secretary, to vice-president. He is succeeded by his former assistant, Erwin H. Steif.

Marvin S. Bandoli (left) is now senior vice-president of Pendleton Tool Industries, Inc. He has been vice-president, marketing, since 1952.
A. E. Carter (right) was elected vice-president of manufacturing at Worthington Corp. to succeed Leslie C. Rickettes now devoting full time to duties as group vice-president of five divisions.

At Houdaille Industries, Inc. E. L. SPENCER was appointed general sales manager of the Buffalo Hydraulics Div. and A. J. Fratianne was moved into the position of general manager of Fairmount Tool & Forging Div. Mr. Spencer has been chief executive at Fairmount since its acquisition by Houdaille in 1955. Mr. Fratianne has been Fairmount factory manager for the past seven years.

HAROLD J. FRYAR, director of manufacturing and a member of the board of The Coleman Co., Inc. was elected vice-president of manufacturing and engineering.

Appointment of JOHN F. MURRAY to the post of chief engineer for its Pesco Products Div. and Wooster Div. was recently announced by Borg-Warner Corp. Formerly manager of product engineering at Pesco Products, his duties now include responsibility for coordinating engineering activities for research and development, product engineering, and production.

FELIX W. BRAENDEL is new president of the Groov-Pin Corp. Formerly executive vice-president of the firm, he has designed much of the automatic production machinery used by the firm.

Two other executive assignments involved MRS. E. F. SCHIEWIND, who was named vice-president and secretary, and F. O. BECKER, now vice-president and treasurer.

ROY CRAMER, JR. recently became new president of Cramer Posture Chair Co. succeeding his father who died last winter. At the same time, HAROLD W. CRAMER assumed the duties of executive vice president, while MRS. ANNA B. CRAMER became chairman of the board and treasurer.

J. DAN MALONE is new general sales manager of The Enterprise Co. He formerly was chief executive of the H. B. Smith Machine Co.

According to announcement from American Chain & Cable Co., Inc., JOSEPH N. KEMPLE has advanced to the post of general manager of the Page Steel & Wire Div. Prior to this promotion, he was division sales manager.

At Pratt & Whitney Co., Inc., ALFORD H. JOHNSON was named sales manager for the Cutting Tool and Gage Div. He previously was sales manager of the mid-continent sales territory. Mr. Johnson is a member of ASTE's Chicago chapter.

At the same time, WILLIAM C. MULLIN became manager of instrument gage sales for the entire country. He has directed sales of these products for the East-West territory only.

Trade Literature

for free booklets and catalogs—use request card, page 175

Tracer Contouring

Comprehensive data on function and performance of air gage tracer contour system for metalworking operations presented in 36-page booklet No. 2609 illustrated with schematics, photographs and line drawings; includes information on remote controlled air-gage tracer lathe designed for contouring explosives, solid propellants and radioactive materials. Request only on company letterhead direct from The Monarch Machine Tool Co., Sidney, Ohio.

Clamping

Application, construction, specification and price data on more than 400 items covered in 52-page Catalog 114 which can also serve as reference work on clamping tools; well illustrated with photographs and drawings; indexed for easy reference. Wilton Tool Mfg. Co., Schiller Park, Ill. **L-11-1**

Resistance Welding

Twelve-page, illustrated Vol. 5, No. 3 of *Resistance Welding at Work* describes resistance welding case histories in both commercial and military fields, including aviation; discusses production advantages and resultant improvements in product quality obtained through three-phase resistance welding. Sciaky Bros., Inc. c/o Dept. L-23. 4915 W. 67th St., Chicago, Ill. **L-11-2**

Milling Cutters

Extensively illustrated 8-page Bulletin No. 582 describes construction of cutters using square and triangular carbide inserts; lists sizes and dimensions and other data of standard shell end, face and half side mills. McCrosky Tool Corp., Meadville, Pa. **L-11-3**

Beryllium Copper Tubing

Data Memorandum No. 7 describes mechanical and physical properties, applications, corrosion resistance, production limits, heat treatment, fabrication and standard size tolerances of small diameter beryllium copper tubing. Superior Tube Co., 1732 Germantown Ave., Norristown, Pa. **L-11-4**

Tool Sharpening

Pocket-size, 32-page booklet, No. 13-25-14, uses light touch to point out the moral of how improper sharpening of a $5 tool can ruin the precision and production obtainable from a $50,000 machine. The Heald Machine Co., 3 New Bond St., Worcester 6, Mass. **L-11-5**

Holding Devices

Twenty-eight page Catalog No. 158 presents line of holding devices to speed production and describes tool application problems and solutions; includes full operation and maintenance instructions with blueprints of devices and dimension tables. Heinrich Tools, Inc., Racine, Wis. **L-11-6**

Switches

More than 200 switches and related devices for industrial and commercial applications described and illustrated in 32-page Catalog 62c pointing out important features, operating characteristics and specific uses for each model in line. Micro Switch Div., Minneapolis-Honeywell Regulator Co., Freeport, Ill. **L-11-7**

Marking Tools

Illustrated, 192-page Catalog No. 16 presents complete line of marking tools, marking machinery and equipment. Geo. T. Schmidt, Inc., 4100 N. Ravenswood Ave., Dept. T.E., Chicago 13, Ill. **L-11-8**

Cemented Carbide

Fifty-page illustrated Catalog No. 59 covers complete line of cemented carbide products; includes base price and quantity extra table data on Kendex tools and boring bars, standard blanks, brazed tools, clamped inserts and Kennamills. Dept. 59, Kennametal Inc., Latrobe, Pa. **L-11-9**

Chemical Milling

Six-page folder describes recent advances in chemical milling of castings; deals with various techniques perfected to improve surface finish of cast parts through the process; includes information on tolerances attainable, suitability, overall and controlled area reduction and surface finishes to expect when casting aluminum, magnesium, magthorium, steel and other cast alloys. United States Chemical Milling Corp., 1700 Rosecrans Ave., Manhattan Beach, Calif. **L-11-10**

Protective Coatings

Reference file of "Porcelain Enamel Engineering Data" serves as aid to design engineers and technical management who need information on protective coatings; includes series of data bulletins, reprints of informative literature and general information about porcelain enamels; lists products, characteristics and properties. Porcelain Enamel Institute, 1145 - 19th St. N.W., Washington 6, D. C. **L-11-11**

Stamping

Four-page Bulletin 301, "More for your Short Run Stamping Dollar," offers detailed information on company's facilities and operation; offers typical examples of costs using company's quotation method; outlines number of designer tips for stamping economy. Federal Tool & Mfg. Co., 3600 Alabama Ave., Minneapolis 16, Minn. **L-11-12**

Nylon Bearing Liners

Eight-page brochure explains design, operating principle, applications and engineering advantages of Nylined bearings and Nyliners; illustrates each type and outlines dimensions and specifications; also gives installation recommendations. Thomson Industries, Inc., Manhasset, Long Island, N.Y. **L-11-13**

Vibrating Feeders

Standard and special model electromagnetic vibrating feeders for hard-to-handle bulk materials covered in 30-page, illustrated booklet; gives complete descriptions, data and specifications for entire line; also shows typical installations and variety of application diagrams. Syntron Co., 340 Lexington Ave., Homer City, Pa. **L-11-14**

Buttweld Tubing

Comprehensive 60-page "Handbook of Cold Drawn, Buttweld Mechanical Steel Tubing" explains steps in buttweld production, finishing and inspection, types of product available through various mill treatments and supplementary forming operations; clarifies engineering and cost considerations; extensively illustrated. Pittsburgh Tube Co., 212 Wood St., Pittsburgh 22, Pa. **L-11-15**

Boring Mills

Floor type horizontal boring, drilling and milling machines described in detail in 12-page catalog which emphasizes design and operating features includes complete specifications; well illustrated. The Cincinnati Gilbert Machine Tool Co., 3366 Beekman St., Cincinnati 23, Ohio. **L-11-16**

Optical Gaging

Both catalog and handbook information presented in 114-page General Catalog No. 10; includes well organized technical data on optical gaging, chart gages and fixturing written in nontechnical language, tab indexed for easy reference; extensively illustrated. Request only on company letterhead direct from Optical Gaging Products, Inc., Rochester, N.Y.

Environmental Equipment

Photos, drawings and charts illustrate 28-page brochure of data on environmental chambers for controlled atmospheric conditions. Includes not only standard specifications of various models in line, but also technical information, temperature conversion chart and pertinent technical data on environmental applications. Webber Mfg. Co., Inc., P.O. Box 217, Indianapolis 6, Ind. **L-11-17**

Twist Drills

Illustrated 28-page pocket-size booklet, "You're On the Road to Better Drilling", shows how improved precision and economy may be obtained in drilling operations; explains spiral point drill geometry and provides record section; treated humorously for easy reading. Cincinnati Lathe and Tool Co., 3207 Disney St., Cincinnati 9, Ohio. **L-11-18**

Electrodes

Data on more than 25 different electrodes and wires discussed in hard surfacing electrode catalog, Bulletin No. MW-222; includes users' guide for selecting correct electrode or wire for use on more than 400 different types of welding equipment. Welding Products Div., A. O. Smith Corp., Milwaukee, Wis. **L-11-19**

Presses

Bulletin 66A presents modernized Series SE straight side, single action, eccentric geared presses for large, heavy tonnage drawing, punching and blanking work; includes information on operating and design features as well as factors governing press speeds, punch speed charts, detailed specifications, data on press accessories and section on presses equipped for automation; well illustrated with detail drawings and photos. Niagara Machine & Tool Works, 683 Northland Ave., Buffalo 11, N.Y. **L-11-20**

Investment Castings

Significant evaluation factors for judging investment castings and selecting casting supplies presented in "How to Buy Investment Castings"; also gives numerous tips and rule-of-thumb guide posts for determining whether or not a part should be considered for precision investment casting process. Mercast Mfg. Corp., 2620 First St., LaVerne, Calif., or Alloy Precision Castings Co., 3855 W. 150th, Cleveland 11, Ohio. **L-11-21**

Sponge Iron

Illustrated by photos and charts, 20-page manual dealing with sponge iron powder as a source of metallics for the steel industry, gives an explanation of melting stock, analysis of sponge iron, carbon and carbon potential and importance of purity; also discusses role of sponge iron in quality steel making in acid open hearth, basic open hearth, electric arc furnace and high frequency furnace. Request only on company letterhead directly from Hoeganaes Sponge Iron Corp., Riverton, N.J.

who's meeting and where

Oct. 30-31. The University of Wisconsin, University Extension Div. Engineering institute on engineering photography. Specific information is available from Engineering Institutes, University Extension Div., The University of Wisconsin, Madison 6, Wis.

Oct. 30-Nov. 1. American Society for Metals. Seminar on Residual Stresses, Cleveland, Ohio. For information on program and registration, contact ASM office, 7301 Euclid Ave., Cleveland 3, Ohio.

Nov. 5-7. Porcelain Enamel Institute. Shop Practice Forum, University of Illinois and Urbana Lincoln Hotel, Urbana, Ill. Institute office, Associations Bldg., 1145 Nineteenth St., N.W., Washington, D.C. can supply facts.

Nov. 5-9. National Tool & Die Manufacturers Assn. Annual convention, Sheraton Hotel, Philadelphia, Pa. For more information, write association office, 907 Public Square Bldg., Cleveland 13, Ohio.

Nov. 6. Society of Plastics Engineers, Inc., Philadelphia Section. Regional technical conference on "Advances in Injection Molding." Request more facts from society office, 65 Prospect St., Stamford, Conn.

Nov. 10-12. Steel Founders' Society of America. 13th technical and operating conference, Carter Hotel, Cleveland, Ohio. Society headquarters, 606 Terminal Tower, Cleveland 13, Ohio, can supply complete information.

Nov. 17-21. Society of the Plastics Industry, Inc. National Plastics Exposition, International Amphitheatre, Chicago, Ill. Get details from society office, 250 Park Ave., New York 17, N.Y.

Nov. 18-20. American Standards Association. Ninth national conference on standards, Hotel Roosevelt, New York City. For details, contact association office, 70 E. 45 St., New York 17, N.Y.

Nov. 30-Dec. 5. The American Society of Mechanical Engineers. Annual meeting, Statler and Sheraton-McAlpin hotels, New York City. For more information write society office, 29 W. 39th St., New York 18, N.Y.

Dec. 10-12. The University of Wisconsin. Engineering institute on industrial plant maintenance. Pertinent data is available from Engineering Institutes, University Extension Div., The University of Wisconsin, Madison 6, Wis.

Jan. 7-9. The University of Wisconsin, University Extension Div. Engineering institute on industrial computer applications. Write to Engineering Institutes, University Extension Div., The University of Wisconsin, Madison 6, Wis.

Jan. 27-30. Society of Plastics Engineers. Annual technical conference, Hotel Commodore, New York City. For more facts, contact James T. Growley, 3 Hilltop Circle, Whippany, N.J., or Guy Martinelli, c/o Sylvan Plastics, Inc., 1617 Pennsylvania 3, Pa.

Jan. 26-29. Plant Maintenance & Engineering Show, Public Auditorium, Cleveland. Complete information is available from Clapp & Poliak, Inc., 341 Madison Ave., New York 17, N.Y.

Feb. 3-5. The Society of the Plastics Industry, Inc., Reinforced Plastics Div. 14th annual technical and management conference, Edgewater Beach Hotel, Chicago. Society office, 250 Park Ave., New York 17, N.Y. can supply more data.

TOOL ENGINEERING in Europe

By M. Kronenberg

Consulting Engineer

Cincinnati 6, Ohio

Automatic Machine Tools

Two principal trends can be distinguished in the development of automatic metal-cutting machine tools, according to an article published by E. Salje' in *Zeitschrift des Vereins Dentscher Ingenieure* Vol. 100, 1958, No. 16, under the title: "Automatisierte Werkzeugmaschinen."

One of the trends is the use of single purpose machines and special machinery for mass production. These machines are usually equipped with relatively simple control systems. On the other hand, automatic machine tools for single pieces and small lots are of the universal type. Their automation requires, according to the author, considerable expense as far as control systems are concerned.

If perforated tape, punched cards or magnetic tape are used for the signals, it is necessary to install electronic devices. A great advantage of this type of machine lies in the fact that rapid changes for machining various sizes and shapes of workpieces are possible. If the control system includes return motion, the workpiece must first be brought into the position corresponding to the desired dimension. The actual dimension is then measured and the difference between actual and desired dimension—the error—compensated for.

The author also discusses economical considerations for comparing various automated machine tools.

Machine Tool Design

Development of the most efficient and least expensive gear train in the headstock of lathes, radial drills and other machine tools is often time consuming. Success frequently depends on chance as well as on the experience of the designer. A book by E. Stephan, chief engineer of a builder of radial drills, outlines a systematic approach to find-

ing the most economical gear train. The book's publisher is Springer Verlag, Berlin West (35). The title is: *Optimale Stufenraeder Getriebe fner Werkzeug Maschinen.* (Translation: "The Most Advantageous Gear Trains for Machine Tools.")

The book is based on the standardized spindle speeds for machine tools first introduced about 25 years ago. Certain advantages of these standard speeds are described in the book and in literature. The first part of the book deals with various types of gear trains, distribution of the geometric progression—which is likewise standardized in Europe—determination of transmission ratios, number of gear teeth and similar topics.

A gear train diagram is extensively used. It consists of a semilogarithmic plot of shaft speed versus shaft number, and permits a survey of the rpm of all gears and shafts involved in a given setting of the drive.

A second part of the book covers the most effective arrangement of the gears. Practical examples are given and their advantanges and disadvantages discussed in comparison with the systematic approach recommended by the author. The bibliography is incomplete.

Moments and loads on the gears and shafts can be determined in a simple way. In one of the examples 15 different possibilities of a gear train are compared in diagram fashion. A method for finding the train that would give the shortest over-all length or compactness is illustrated.

Metal-Cutting Research

In a great number of scientific publications on metal-cutting the forces acting at the flank of the tool are disregarded. A new method of investigating these forces has been developed by G. Roehlke and used in about 3000 tests run by him while working on a doctoral thesis at the Technical University of Karlsruhe. An abstract of his findings was published in August 1958 in *Werkstatt und Betrieb* No. 8, under the title "Zur Mechanik des Zerspanvorganges."

In order to obtain a cut without engagement of the end-cutting edge—as is the rule in these tests, usually performed at the face of a tube—the author attached a second tool upside down, opposite his "active" tool and was able in this way to remove the material usually cut by the end-cutting edge before engagement with the active tool. The setup was considerably more rigid than the conventional method and it was possible now to measure the tool flank force independently.

The author used his tests to compare basic metal-cutting formulas developed by Hucks, Krystoff, Stabler and Kronenberg. This last formula, published in

THE TOOL ENGINEER of April 1958, and presented also as paper No. 86 at the 1958 ASTE Annual Meeting, takes the dynamics of cutting into consideration, which has not been done before. In this writer's opinion the *true* strain and *true* stress are introduced into metal-cutting in this way. Roehlke concludes, on the basis of 3000 tests, that, "Kronenberg's recently developed equation for the shear angle was found to have the greatest probability (of validity)." This confirmation is outlined at numerous places in Roehlke's paper. He also concludes that the force at the flank of the tool is about one-third of the cutting force, and illustrates the relationship between true rake and shear stress, and between chip compression and shear stress, as well as numerous other relationships of great interest in development of metal-cutting science.

Noise Reduction on Turret Lathes and Screw Machines

Noise produced by the bar stock fed into turret lathes and automatic screw machines is the topic of an article by H. Jaeger in *Werkstatts-Technik und Maschinenbau*, No. 8, 1958. In an article called "Laerm Minderung bei Stangenfuehrungen an Revolverbaenken und Antomaten," the author describes some basic concepts and also a number of German patents and Russian designs for noise reduction. It is not sufficient to prevent bending of the bar stock; vibration must also be dampened. A tube with an inside diameter just slightly larger than the diameter of the bar stock represents the "ideal" condition. This, however, is not practical in cases where the workpiece diameter must be changed very often. Rotating tubes should be made of light metals in order to reduce the time for acceleration and stopping of the stock. Heavy-wall tubes, lining with plastics, noise isolation etc. are also discussed.

Spark Erosion Machining

Two articles in *Industrie Anzieger* Vol. 80 (47), 1958, deal with spark erosion machining. The first one, by K. Ganser covers the machining of carbide tools. It is found that different electrodes must be used than on HSS tools. The second article by H. Obrig discusses the formation of tool electrodes for spark erosion of dies.

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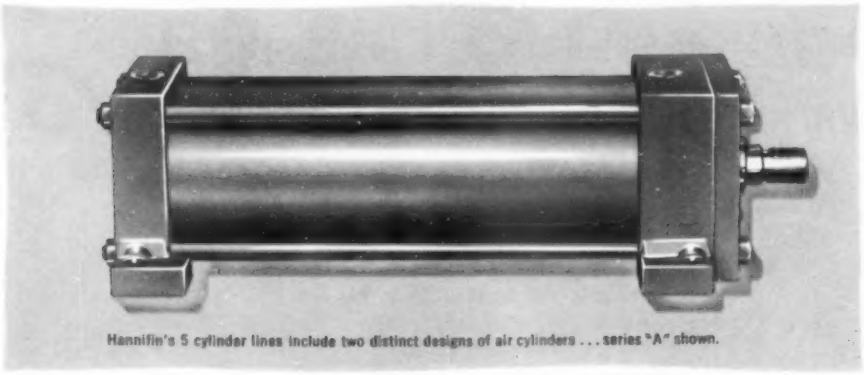

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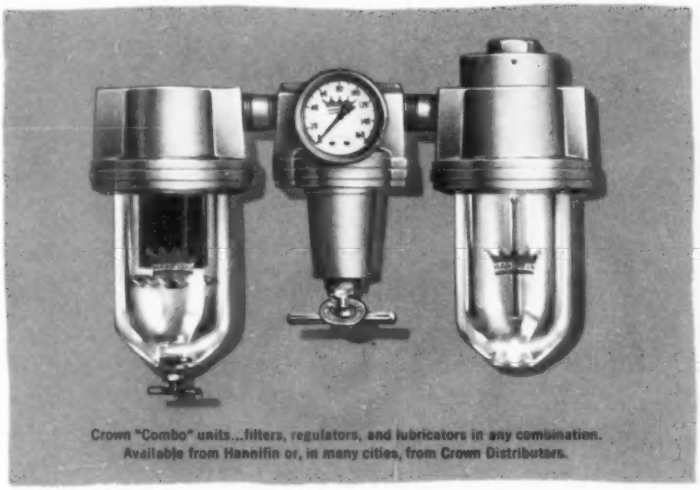

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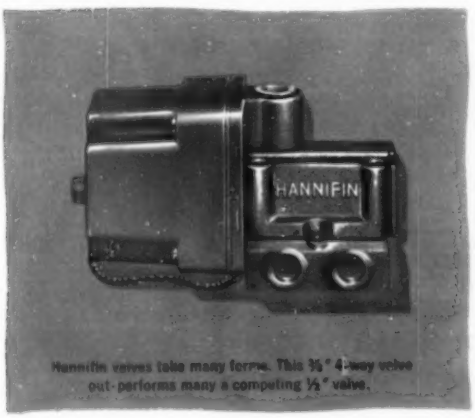

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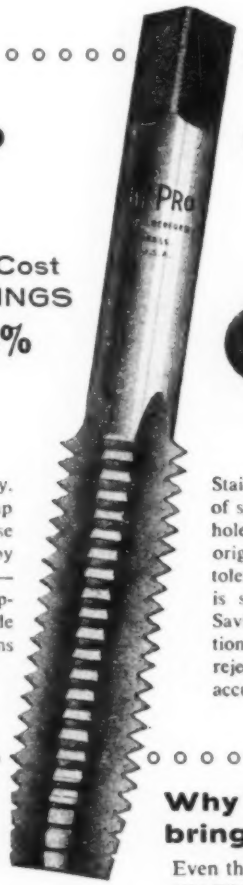

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Readers' Viewpoints

. . . OVERPIN MEASUREMENTS

To the Editor:

It was gratifying to see the errors corrected in Mr. Louis Martin's article in the July, 1958 issue of THE TOOL ENGINEER.

The author states, "an approximate formula has been used by the author for more than seven years." He did not mention the fact that the formula had been published at least 20 years ago by Prof. Buckingham. Seventeen years later, this authority abandoned the use of this formula for a more precise method. (see *Machinery*, page 162, 1945).

Mr. Martin states that, by contrast to the method given in the *Van Keuren Handbook*, the formula he uses gives quicker and sufficiently precise results. His claim for quicker results does not hold true if the selected worm or screw is within the range of the values tabulated in the Van Keuren tables. In that case, the total calculating time does not exceed two minutes time since no trigonometry is required. However, I would like to suggest that the range of those excellent tables should be extended where necessary.

Mr. Martin's claim of sufficient accuracy for the formula he uses is disproved by the fact that his numerical example would show twenty times greater error if he had applied the formula to a worm twenty times enlarged in all linear dimensions. Thus, the error of that formula for a 5.240-inch pitch diameter would have the value of approximately 0.007 inch. The toleration of inspection errors of almost a hundredth of an inch would defeat the very purpose of any modern measurement. Furthermore, the Martin method contains an unlimited inaccuracy by the fact that he does not supply a formula for the proper selection of the pin diameter. When he checked his values against the precise Van Keuren values, it was implied that he used the Van Keuren pin size exactly calculated for contact at the pitch diameter. Pins differing from the proper size will contact the surfaces of the worm at points where pressure angles prevail completely different from those specified.

In addition, his statements about the needed and obtainable accuracy of a pin measurement cannot be completely accepted without contradiction. Sometimes measurements of precision screws and worms are needed to a much greater accuracy than that yielded by a micrometer caliper.

During 1946, the writer encountered a triple-start screw with less than an inch pitch diameter on which several men used different approximate formulas to compute over-pin measurements. The results differed over a range of 0.024 inch. In desperation, the screw was changed to the nearest equivalent involute screw which could be handled by exact methods during generation and measurement. The Vogel exact equations in the *Van Keuren Handbook* would have saved many weeks of calculations had they been available.

In all measurements, a comparison with a certain geometrical ideal is used. This principle is incorporated in Dr. Vogel's mentioned exact equations referring to an ideal screw of given specifications. Without such an ideal, there would be no possibility of judging the accuracy of any approximation, including that used by Mr. Martin.

There is merit in Mr. Martin's statement that some of today's worm and worm gear manufacturing procedures would justify measuring accuracies considerably lower than those offered by the Vogel Master-Formula No. 800 in *Van Keuren Handbook* 36, 1955. However, the use of simple approximate equations should be guided by a definition of their limitations with suitable error curves or charts as they are given in all Vogel approximate formulas.

Joseph Silvagi, VP
Camdale Precision, Inc.
Rosedale, Michigan

To the Editor:

At the very beginning of my article, credit was given to gear authorities for their scholarly work. In my humble opinion, Dr. Vogel's work on over-pin measurements of screw threads will go down in history as a monumental job.

It is the considered opinion of some of this country's outstanding authorities, however, that over-pin measurements of power transmission worms have many practical shortcomings. It is also generally believed that they should be regarded as only useful for comparative purposes, but cannot be used to obtain absolute values of size since many factors of a greater order of importance are interrelated with size.

Worms should be classified with bevel gears and similar three dimensional types of gearing in that the exact size of one member cannot be determined accurately without the knowledge of size of its mating member. Tooth bearing and position of bearing are of greater importance than a knowledge of absolute size. Two conjugate members, worm and gear, can vary appreciably from some mathematically accurate norm of size as long as they are conjugates of each other and mesh correctly at the proper center distance.

Whether all the allowance for backlash is made in the work or gear, or is divided in two, is moot and depends on the conditions of generating and application. The eight conclusions reached in my article are based upon experience in gear design.

I have recently consulted with six of this country's outstanding worm gearing authorities. There is concensus that

1. Size of a worm is related to the size of its mate. Without a knowledge of size of one, size of the other cannot be accurately determined with a complete degree of certainty.

2. Profile geometry and tooth bearing, is extremely important when attempting to make a size check. Profile geometry of worms is the result of the manufacturing process and the worm profile shape is altered by many factors depending on methods of manufacture, size of cutter, etc.

3. That size of worms determined by means of pins is, at best, an approximation, exact size determination must be made by meshing a worm with its mating gear at the operating center distance and noting the changes therefrom. Nature of tooth contact is vital to correct performance. With a faulty bearing, worm gears cannot be expected to transmit the computed loads nor uniform angular motion. Pin measurements do not take this into account.

4. Once an acceptable worm is obtained, pins may be used for comparative purposes to make others like the first one.

5. The inherent limitations in the manufacturing and measuring processes outlined subordinate over-pin measurements to secondary place as an accurate means of determining size of worms.

Mr. Silvagi refers to the existance of the much older Prof. Buckingham's formula. If I had known of its existance, I would have used it.

If the example I gave in my article were scaled up twenty times as Mr. Silvagi suggests, the computed error will be approximately 0.007. Let us see what such a worm would look like. The proportions, measured in inches, are: pitch diameter, 5.240; outside diameter, 7.277; whole depth, 2.292; lead, 3.200, and axial tooth thickness, 1.600. Such a heavy-duty worm would be capable of providing all the ventilation necessary in one of the tubes in the Lincoln Tunnel. An allowable backlash of 0.020 to 0.030 inch would be within reason. Thus, the approximate over-pin measurement could be +0.000, −0.080 inch.

It will be seen that a deviation of 0.007 inch is of no consequence. What is of much greater consequence than size, in a drive of this kind, is nature and position of tooth bearing.

The triple-threaded worm which gave Mr. Silvagi trouble points to what has been mentioned; namely, that knowledge of profile shape is necessary for size determination. When he made the worm with an involute profile he was sure of it. Pin measurements could then be applied more readily. This undoubtedly was not the case when he produced the work by conventional methods in which case the exact profile shape, at the point of pin contact, was questionable.

Coming to the last point raised by Mr. Silvagi, he says that the new Vogel tables avoid calculations because one finds the pin size directly. This is true only when one has a wide variety of exact pin sizes on hand.

The *Van Keuren Catalog No. 36* gives specific information on the method of measuring wires. Page 198 of this catalog states: "In order to measure the screw-threaded gages to an accuracy of 0.0001 inch by means of wires, it is necessary to know the wire diameter to 0.00002 inch."

Few shops have wires on hand in a large variety of sizes that are accurate to 0.00002 inch. The VanKeuren people recognized this because on page 209 of their book they give a means of approximations for wires on hand.

Let us assume that we did not have a wire of 0.08387 inch on hand, in the example we gave, but used, instead, an 0.080 inch wire. The approximate formula would have resulted in an over wire measurement of 0.3601, while the "VanKeuren approximation would have resulted in 0.3599, the difference between one and the other approximation is 0.0002 inch as before. Many consider this difference insignificant.

If a wire is used which was verified to be accurate at 2½ pounds pressure and some other pressure is used, it is no longer standard. When we start tossing a few tenths of thousandths around, everything must be considered.

L. D. Martin
L. D. Martin & Associates
Rochester, N. Y.

It is regrettable that a typographical error occurred in the approximate formula in Mr. Martin's article. This error was corrected in the September issue on page 85. In addition, the value for t_s should have specified the thickness of tooth space measured in the normal plane on standard pitch diameter—ED.

Industrial Use of ADHESIVES

By F. J. Wehmer
Minnesota Mining and Mfg. Co.
Detroit, Mich.

Tech Digests

An adhesive is a substance applied as a thin, intermediate layer between two bodies to hold them together by surface attachment. This definition can cover a wide variety of materials and allows these materials to be applied by many methods.

Adhesives are not materials which have suddenly come into being, but have been used for many centuries. The natural occurring gums and resins have been used since before the time that man began recording his history. We sometimes get the notion that the adhesives that the ancients used were not very good ones. However, some of the inlaid furniture and veneers which have come down from antiquity are still in very good condition and, as a consequence, the adhesives which were used must have had merit.

Why Use Adhesives: Through the use of adhesives it is possible to distribute stresses over the entire joint area which eliminates local stress concentrations. This allows the use of lighter gage material to produce the same strength and rigidity, thus saving weight and costs on the products.

Since these materials provide continuous contact between mating surfaces, it is possible to seal and bond in one operation. The adhesive will also provide electrical insulation and will prevent galvanic corrosion between unlike metals. Since water cannot be trapped, it prevents corrosion at the joint when ferrous metals are joined.

Their use provides smooth contours which eliminate the necessity of finishing to get a pleasing surface. Gaps and bulges are eliminated and there are no external projections as with some types of mechanical fasteners.

When using adhesives it is not necessary to drill holes and, as a consequence, stress concentrations are eliminated. This often increases the fatigue life of an adhesive bonded part. By choosing the right adhesive, it is possible to get a flexible joint and this makes it possible to adhere flexible materials to other flexible materials or to rigid materials.

It is often possible to save space by the use of adhesives and thin sheets may be adhered without distortion. This is true where it is necessary to adhere metal foil to either rigid or flexible materials.

It would seem that adhesives had no disadvantages, but this, unfortunately, is not true. Time is required for the making of a bond and certain materials, for example, Teflon, are hard to bond. Most of the known organic type adhesives have definite high temperature limitations and some adhesives are adversely affected by solvents or water.

Where To Use Adhesives: It is hard to make a rule which indicates where adhesives should be used. The place where there would be no question about the use of adhesives would be in a spot where there is no other way of fastening two materials together. An example of this might be the adhering of very thin metal foils to other materials where it would not be possible to use welding or mechanical fastenings.

Another place where adhesives might be used is in those places where there is an economic advantage. In a good many cases, by use of adhesive materials, savings in costs can be obtained in the

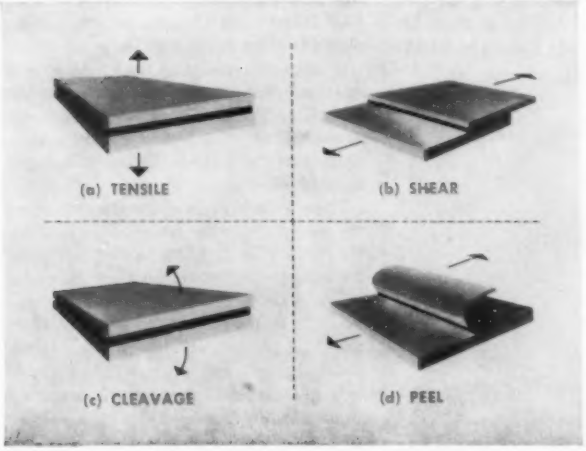

Fig. 1. Basic types of adhesive joint stress for various loading conditions.

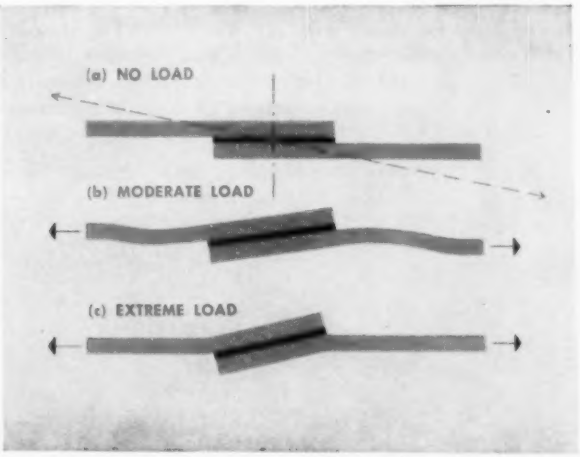

Fig. 2. Reorientation of shear bond under conditions of increasing load.

fastening of one material to another. Included in this category are those places which would dictate the use of an adhesive for esthetic purposes.

The third place where to concider the use of an adhesive is in those spots where high strength to weight ratios are needed.

Which Adhesives To Use: Everyone is familiar with the ordinary types of glues (animal, vegetable) which are used for the fastening of paper to paper. It would seem that many people believe that these should not have a place in industry because of the many advances that have been made in the last few years. However, one needs only to consider the economics of using other types of materials in place of the glues and starches and it can be seen immediately that these materials have a very definite place in the industrial system. The use of these materials has increased very markedly during the period when the newer types of adhesives have been coming to the fore.

The thermoplastic type of adhesives may be natural resins or rosins and the synthetic types of resins such as the vinyls. These materials are such that when heated, will soften, and when cool will regain their original strength. Obviously, there are many places where materials of this kind could do an excellent job, but should not be used in places where elevated temperature plays a part in the use of the final bond.

There are also the thermosetting type of adhesives which are normally synthetic resins of one type or another. Through chemical action or by means of an activator or accelerator cross link in such a way that after having been cured, they are much less susceptible to temperature variations than are the thermoplastic adhesives.

How To Use Adhesives: Another important factor in the use of adhesives is the correct design of the joint in which the adhesive is going to be used. It might entail seeing that they are applied properly and are cured, or at least given the best opportunity to do a good job. More adhesive jobs are bungled through the misuse of the adhesive than by using the wrong adhesive.

In considering the use of adhesives in various joints, it should be remembered that almost all adhesives have much better strength in shear than in direct tensile or in peel. By designing a joint correctly it is possible to take advantage of the good properties which adhesives have and to minimize the effect of the weaknesses. When adhesives were first being considered for helicopter blades, it was felt that some precaution should be taken to see that the adhesive could not be peeled easily and, as a consequence, in the first blades that were made with adhesives a few rivets were placed at various points. These rivets were the start of fatigue cracking and, of course, the blades were a complete loss to the company.

In later blades, these adhesives were not protected by rivets and did an excellent job. There isn't too much chance of peel being exerted on adhesives in this particular usage. In fact, the adhesive bonded blades lasted more than three times as long as the riveted type.

In *Fig.* 1 the ways are illustrated in which stresses can be applied to a bond. In *Fig.* 1a, the force being applied is pure tensile. When a load is applied perpendicular to the plane of the joint, all of the adhesive is under stress. The stresses in a joint under tension are easy to calculate and adhesives give a good account when used in this way.

In *Fig.* 1b, a bond loaded in shear is indicated. The stresses are parallel to the joint and again all of the adhesive is under stress at the same time. Adhesives used in this way probably have the maximum effectiveness and joints should be designed to take advantage of this fact wherever possible.

In *Fig.* 1c, a bond is being stressed under cleavage. A concentration of forces is located at one side of the bond while the other side carries very little or none of the load. It is difficult to calculate the stresses in a joint of this type and wherever possible adhesives should not be used where subjected to this type of stress.

Fig. 1d shows a bond being stressed in peel. In many respects peel and cleavage are alike, the difference being that peel requires at least one of the stressed members to be flexible. When a bond is pulled apart by peeling all of the stress is concentrated in a line. This makes a very small portion of the adhesive carry all of the load and joints should be designed to avoid stressing in peel.

Joints usually are not subjected to only one of the loadings we have discussed. In most cases, it is more likely to be a combination of the various types. The reason for this is quite easy to see, since most adherends are not completely rigid and, as a consequence, when they deform we introduce combinations of stresses. This can best be shown by how elastic materials deform under shear loading as in *Fig.* 3.

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The elastic material necks down and at the edges there will be cleavage forces, and if the deformation goes far enough may even become peel. It is plain that the adhesive is not being used only in shear.

Even where rigid materials are used we do not get shear only. This is illustrated by *Fig.* 2, where under moderate load there is an indication that the stress is not all in shear and at extreme loads it is apparent that stresses other than shear are acting on the bond. Scarfed joints and other design changes will get the maximum work from an adhesive joint.

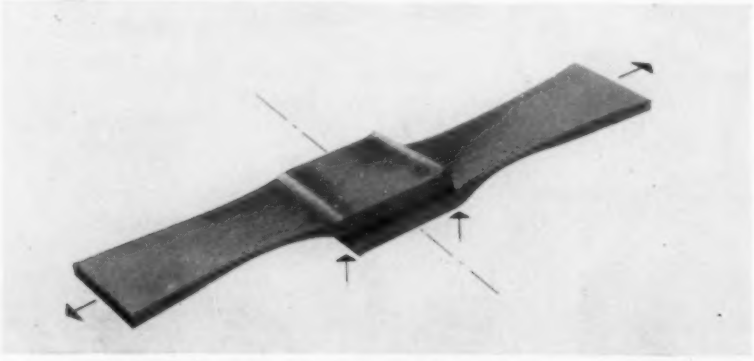

Fig. 3. Deformation of elastic material under shear loading.

Based on a paper presented at the National Production Forum and Meeting of the Society of Automotive Engineers, Inc., 485 Lexington Ave., New York 17, N.Y.

Response of Complex Structures From Reed-Gage Data

By Sheldon Rubin

Technical Staff
Hughes Aircraft Co.
Culver City, Calif.

The papet considers the general applicability of the reed gage, an instrument whicn records the peak response to a transient motion of single-degree-of-freedom systems. These recorded data permit the calculation of peak response in each vibrational mode of a complex structure experiencing the measured excitation as a base motion. An upper bound to the maximum structural response can be obtained by summing the peak responses in each of the modes. An analysis is made of the error inherent in this superposition process. In many practical problems the distribution of mode frequencies and the form of the excitation is such that this error is not of great significance.

In the actual design of the reed gage the displacements of the individual reeds inevitably will depart slightly from those of the ideal single-degree-of-freedom systems assumed in the theory of the instrument. A method of making a correction for this departure and thus obtaining ideal single-degree-of-freedom displacements is described.

The calculation of the maximum response of a complex structure from reed-gage data can only be approximate since the time relationships between the peak responses in the various modes are unknown. A direct superposition of the peak motions in each mode will give an upper bound to the maximum response of the system and hence as a design procedure, the approximation would always be on the conservative side. To investigate the errors in a specific case the response of a two-degree-of-freedom undamped system to a half-sine pulse of acceleration is studied. The following conclusions are reached:

1. Errors are largest when the two modes lie in different regions of the response spectrum; e.g., one mode lies in the impulsive and the other in the static region of the response spectrum.
2. For a single-pulse-type excitation, it is unlikely that the most unfavorable error situations often will occur. In most practical problems the distribution of mode frequencies and the form of the excitation is such that the total error due to superposition is probably not greater than 10 percent. In view of the inaccuracies inherent in the

reed gage, it appears that superposition errors are not usually significant.

3. The superposition errors mentioned in the first conclusion are based on the assumption that nothing is known about the specific shape of the excitation function. If some information of this nature is available, corrections of the maximum response should be possible. There does not appear to be any general correction procedure that can be based on response-spectrum information alone with an assurance of overestimating the response.

Based on a paper presented at the West Coast Conference of the Applied Mechanics Div., Los Angeles, Calif., Sept. 8-9, 1958, of The American Society of Mechanical Engineers, 29 W. 39th St., New York, N. Y.

Cost Reduction In Missile Manufacturing

By Conrad D. Bliss
Chief Mfg. Engineer
Bendix Products Div.—Missiles
Bendix Aviation Corp.
Mishawaka, Ind.

The cost of missiles can only be reduced by a full understanding of all the factors that make them so costly. The complexity and functional requirements of missile parts are running a neck-and-neck race with the capabilities of our machines and processes to shape and fabricate the materials required.

A guided missile is a very expensive bullet. A miss with this missile is expensive from the standpoint of dollars lost, but it may be even more expensive if you are not around any more to take a second shot. Reliability of near 100 percent is a must as an objective.

In considering a constructive and positive program for cost reduction may be purely practical by assuming certain things. Lot sizes, in some cases, are going to be small. Engineering changes are going to remain as an important factor. As the art progresses, these may become fewer, their effect may be reduced, but some changes are surely going to remain. Freezing of designs can be only relative.

Assuming we are going to be working with these conditions the following positive steps should be taken.

1. Earlier freezing of designs using a block change system whereby changes, other than real emergency changes, are made only in groups on block quantities of the total production order are very helpful if "teeth" are put into the system so that every change cannot be termed an emergency change.

2. Penetrate the fog surrounding the design concepts of reliability and long life. Design for the highest possible reliability but do not assume that because we design for extremely long operating life, we are getting any greater reliability for the short life required.

3. Select tolerances in a more analytical manner. Stop the routine use of block tolerances printed in the corner of a drawing title block. It is admitted that some benefit may be derived from this practice in terms of familiarization of a standard practice. The cost of production in most cases is many times greater than any benefit derived.

4. Select materials and required finishes, treatments, and strength designations on drawings on a basis of actual design requirements. Stop using the most aristocratic materials available unless they are actually required, and stop using materials that have been habitually used in similar parts where long fatigue life has dictated their use. Use instead some of the better grades of free-cutting steels, free-machining aluminum, unheat-treated aluminum casting and wrought alloys.

5. Get away from toolroom methods in production engineering. Evaluate the effect on total cost of employing more tooling, even when runs of parts are short. Design tooling to make setup as rapid as possible so that small quantity releases will have minimum setup charges.

6. Set work standards on as many operations as possible and enforce them to the greatest degree possible. Standards are admittedly hard to set accurately on short-run operations. It is made difficult

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by learning curves and also due to interruptions involved in executing engineering changes. Delays brought about by necessary in-process testing also make accurate standards more difficult to establish. Take advantage of some of the benefits of line type layout modified in such a manner that it is easy to remove a missile or subassembly from the line flow in order to make special tests or do special repairs or "fixes."

7. Exercise good factory management in the selection and maintenance of workers and machines. The transition from development and experimental models to production missiles sometimes presents a problem. Production foremen quite naturally tend to be drawn from the experimental shop due to their excellent knowledge of the job details. They are often attuned to an experimental pace and may not necessarily make good production supervisors. Likewise, key workers may be drawn from the experimental shop and may not easily fall in line with production work standards. They tend to bring the experimental pace with them. Look for skilled machinists and assembly workers who have some production experience.

8. Select key production control and material control people who are familiar with missile parts, and who can understand the effects of engineering changes on parts.

9. Set up rigid systems and parts designation procedures for handling production parts. The control and scheduling of material and parts is made more difficult due to the number of parts and frequent changes. Accurate designation and routing is essential due to the fact that changed parts often look alive.

Based on a paper presented at the National Aeronautic Meeting, New York, N. Y., Society of Automotive Engineers, Inc., 485 Lexington Ave., New York 17, N. Y.

▼ ▼ ▼

Factors Influencing the Performance of Grinding Wheels

By E. J. Krabacher

Sr. Research Supvr.
Physical Research Dept.
Cincinnati Milling Machine Co.
Cincinnati, Ohio

Optimum utilization of grinding wheels can best be achieved if the nature of their performance and wear characteristics, and the factors that affect these characteristics, are understood and applied. As reported in this paper, a comprehensive, continuing, grinding research program has contributed to such an understanding.

A study of the nature of grinding-wheel wear indicates that the grinding wheel wear curve is similar to those of other cutting tools. It demonstrates further that the type of grinding operation significantly affects the nature of wheel wear. A unique technique has been developed for very accurately measuring grinding wheel wear. This measured wear may be translated into terms of "grinding ratio," which is the generally accepted parameter for measuring wheel wear. It is the ratio of the volume of metal removed per unit volume of wheel worn away.

Extensive studies have been carried out to determine the effect of mechanical variables on grinding ratio, power required in metal removal, and on surface finish. Experimental findings indicate that grinding ratio decreases with increased metal removal rate and increases with workpiece diameter, decreased chip load, and increased concentration of grinding fluid. Power is found to increase with both the metal removal rate and the amount of metal removed.

Fundamental research in the mechanics of wheel wear is supplying much additional information in the study of grinding wheel wear. The measurement of grinding forces employing a cylindrical grinding dynamometer provides the opportunity for relating the wear of grinding wheels to the basic mechanics of the process through such fundamental quantities as grinding forces, specific energy and grinding friction.

Two additional experimental techniques for the study of chip formation in grinding have also proved to be most

useful research tools. A "quick-stop" apparatus is used to freeze the grinding action by accelerating a tiny workpiece almost instantaneously to grinding wheel speed. Another technique permits the comparison of the shape of the grinding grit and that of the contour of its path through the workpiece by a unique duplicating method.

Based on a paper presented at the Semiannual Meeting, Detroit, Mich., June 15-19, 1958, of The American Society of Mechanical Engineers, 29 W. 39th St., New York 10, N. Y.

▼ ▼ ▼

A Theory of Elastic, Plastic, and Creep Deformations

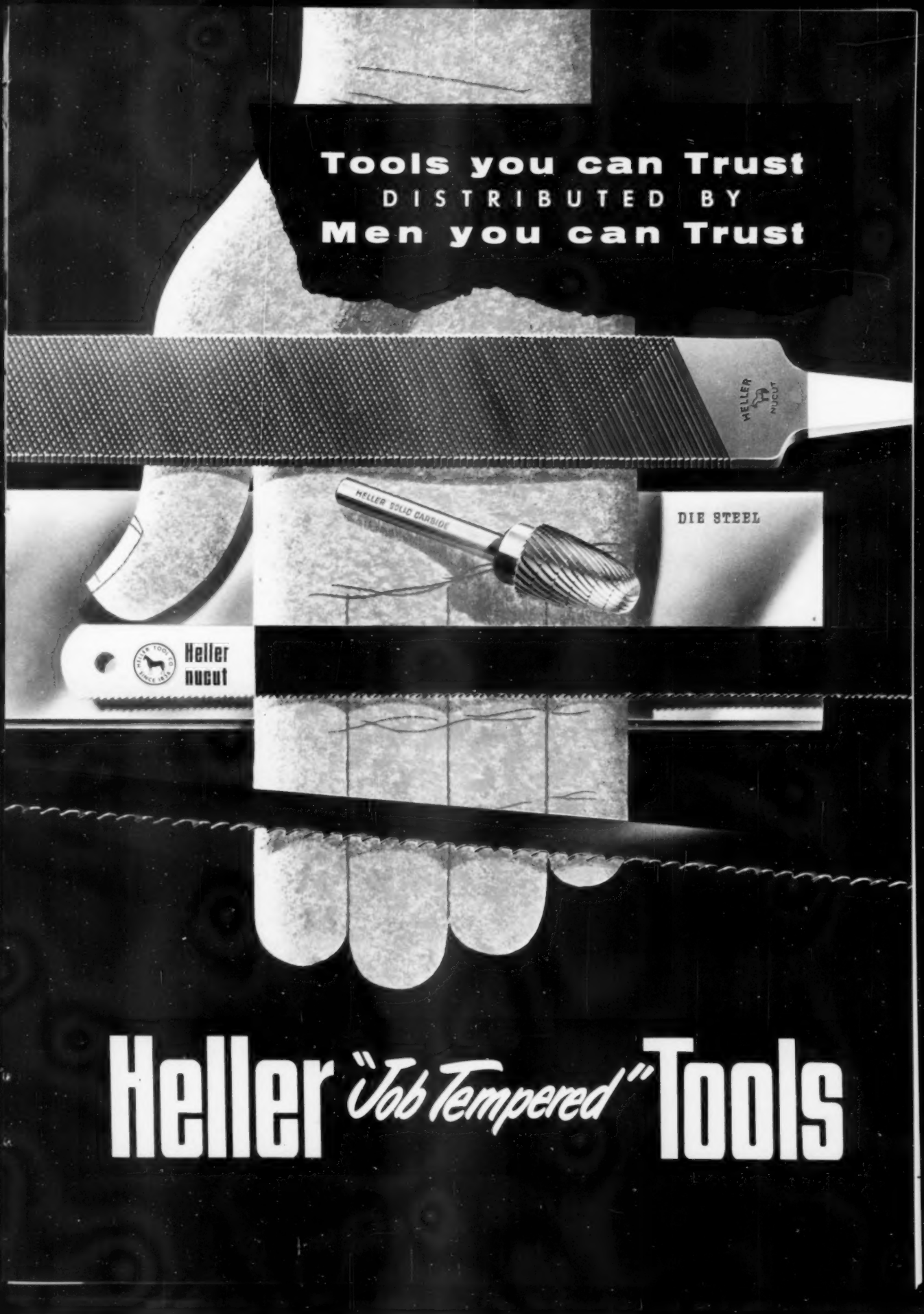
By J. F. Besseling

Research Associate
Div. of Aeronautical Engineering
Stanford University
Stanford, Calif.

Stress-strain relations are given for an initially isotropic material, which is macroscopically homogeneous, but inhomogeneous on a microscopic scale. An element of volume is considered to be composed of various portions, which can be represented by subelements showing secondary creep and isotropic work hardening in plastic deformation. If the condition is imposed that all subelements of an element of volume are subjected to the same total strain, it is demonstrated that the inelastic stress-strain relations of the material show anisotropic strain hardening, creep recovery, and primary and secondary creep due to the nonuniform energy dissipation in deformation of the subelements. Only quasi-static deformations under isothermal conditions are considered. The theory is restricted to small total strains.

The stress-strain relations for inelastic deformations which have been derived in this paper are based on a mathematical, rather than a physical, model of the deformation process of an actual material. It has been shown that they give qualitatively a good description of the phenomena that have been observed in the deformation of metals and other materials. No attempt has yet been made to obtain a comprehensive quantitative comparison between the predictions of the theory and the available experimental data.

Based on a paper presented at the West Coast Conference of the Applied Mechanics Div., Los Angeles, Calif., Sept. 8-9, 1958, of The American Society of Mechanical Engineers, 29 W. 39th St., New York, N. Y.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Here's a case where optical gaging is the only practical answer

The heart of the central dial switching system made by Stromberg-Carlson, Division of General Dynamics Corporation, is the XY* Universal Switch.

A key "muscle" in this heart is a small wiper spring, whose 24 exact dimensions resisted measurement by mechanical means. Yet any flaw in this critical component could seriously impair telephone service.

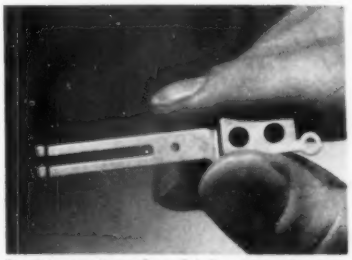
With the Kodak Contour Projector all 24 dimensions of this wiper spring are optically gaged to tolerances of $\pm .0005''$—and the job takes just *three minutes.*

In this case Stromberg-Carlson found that optical gaging was the *only* practical inspection method. Special mechanical gages could have been devised, but then inspection would have taken—not three minutes—but as much as an hour per part.

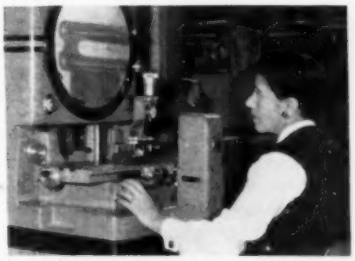
Because Stromberg-Carlson makes and uses a wide variety of complex, hard-to-inspect products, the company uses 9 Kodak Contour Projectors in its Telecommunication Division, alone. They solve problems in receiving, production, and tool inspection as well as in final inspection.

If you have a gaging problem that involves close-tolerance measurement of precision parts with many dimensions, you can probably solve it best with a Kodak Contour Projector. To find out how optical gaging can help you, send for the booklet "Kodak Contour Projectors."

*XY is a registered trademark of Stromberg-Carlson



Final inspection of a 24-dimensioned wiper spring, a vital part of Stromberg-Carlson's dial switching mechanism, is practical only with optical gaging.



In another inspection area, an operator easily measures the critical dimensions of a relay lever arm with a Kodak Contour Projector to assure exact tolerances.

Apparatus and Optical Division

EASTMAN KODAK COMPANY, Rochester 4, N. Y.

the KODAK CONTOUR PROJECTOR

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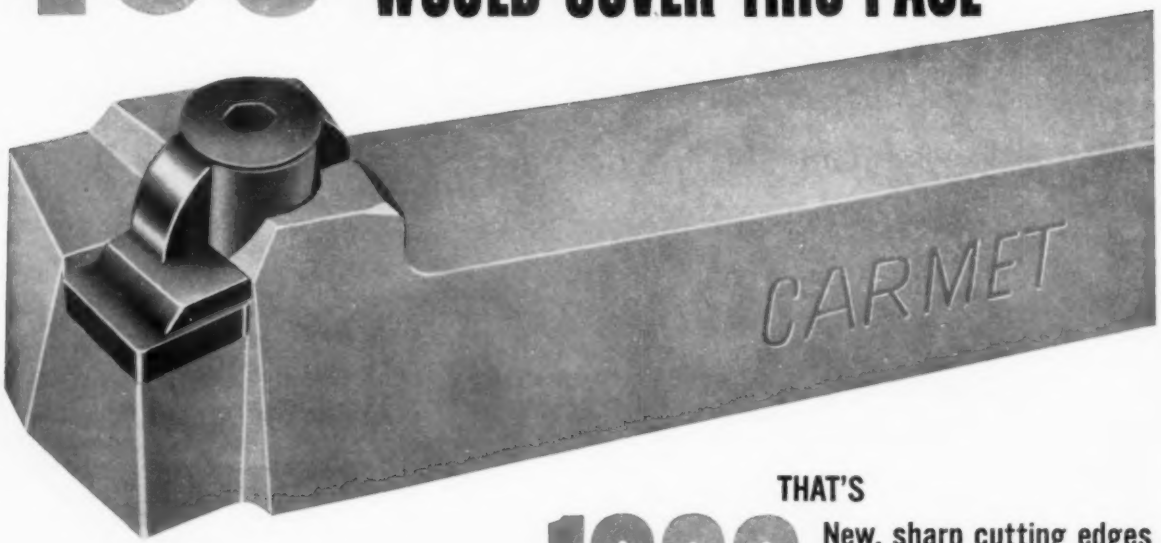

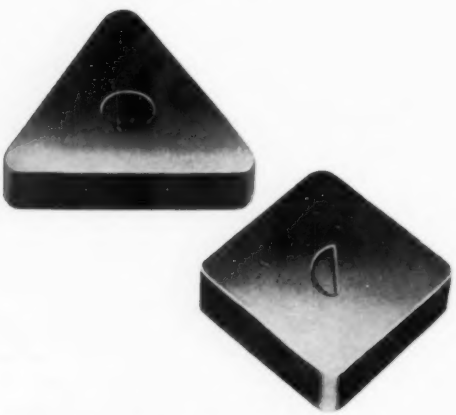

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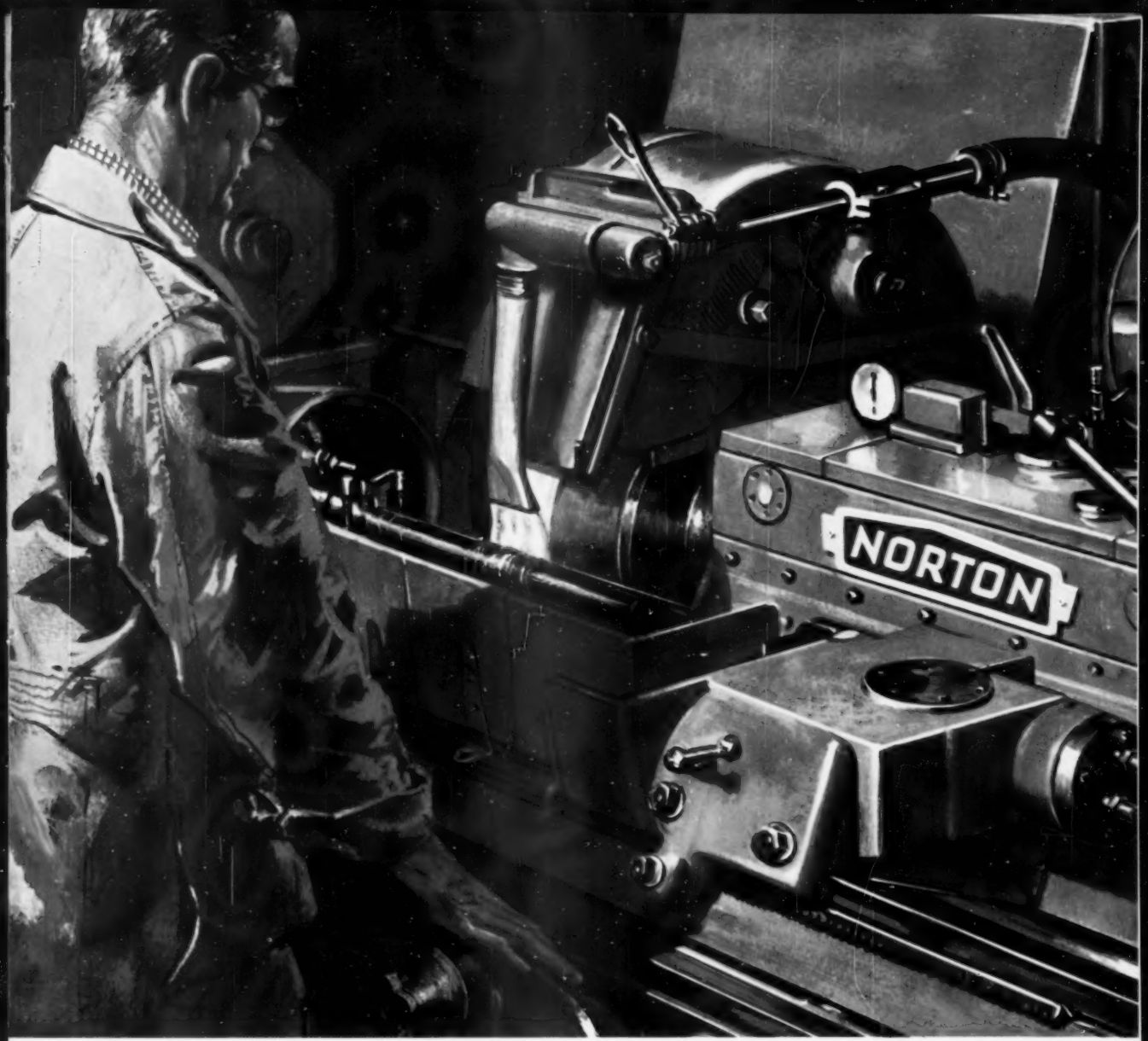

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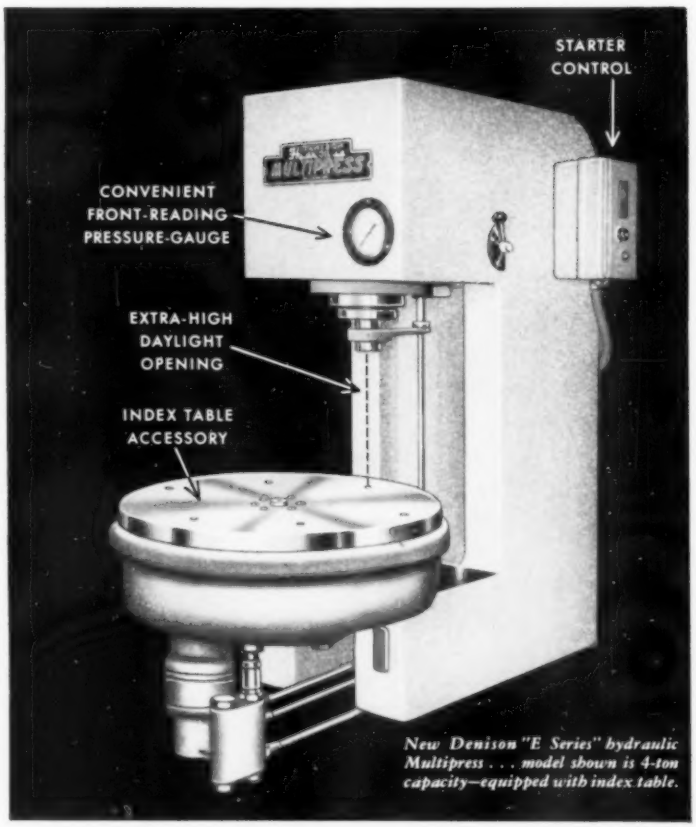

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Precision Tool News

NO. 8 B·S REPORTING NEW DEVELOPMENTS AT BROWN & SHARPE'S PRECISION CENTER

New B&S Transistorized Electronic "Super Hite-Chek" Offers .000005″ Accuracy, Needs No External Connections, is Easy to Use

BROWN & SHARPE has developed the first height-transferring tool that combines the friction-free *accuracy* of electronic measuring with the compact *convenience* of an ordinary height gage. The No. 581 Super Hite-Chek is self-powered, self-contained, easily carried to surface plate or machines.

Its indicating meter travels *on the same slide* with the gage head . . . connects neatly to a battery-powered, transistorized amplifier *in the tool's base*. Measurements are repeated accurately within .000005" over a 0" to 36" range . . . easily, because the meter is always at the measuring height, and there are no external cords, power supplies or other components to "get in the way". The batteries are long-lived, inexpensive, easily replaced.

For rough adjustment, the slide is moved and the gage head tilted "to contact" by a knurled nut. A selector knob on the tool base is turned to "Battery Test" (needle should swing off-scale to right) and then "On". Fine adjustment is made electronically by turning the "Zero Adjust" knob until the meter needle centers on "O". The meter reads from minus .0005" to plus .0005" and spreads each .0001" out about ¼" on its scale; each division is .000025". Gage head is reversible for measuring "under" surfaces. Range: 0" to 36".

New "Ready Mark" Air Hardening Flat Stock Available for "Low Distortion" Applications

261 sizes of precision ground tool steel designed for air hardening have been added to the Brown & Sharpe Ready Mark line. Containing 5% chrome, this stock is ideal for dies or other work where distortion during hardening must be minimized. Comes coated with a smooth, maroon finish, all ready for scribing.

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THANK YOU, DETROIT!

THANK YOU, MICHIGAN!

We came to you when you were having your problems. We shared them with you. You have given us a wonderful welcome and we appreciate it.

Everyone has been most helpful -- our new neighbors, the Board of Commerce, City and State officials, the Post Office, your Tool Engineers, our old and new customers, even our competitors.

We came to give you the same high quality and unique service that has made us grow from a little western firm to a Nationally-known leader in the drill bushing industry. Our primary purpose is to give you top quality drill bushings at competitive prices exactly when you need them.

So again we say, Thank you, Detroit -- Thank you, Michigan, for making us a part of your community and economy. We pledge ourselves to do for you what we have done in other places.

ACE BUSHING CO., INC.

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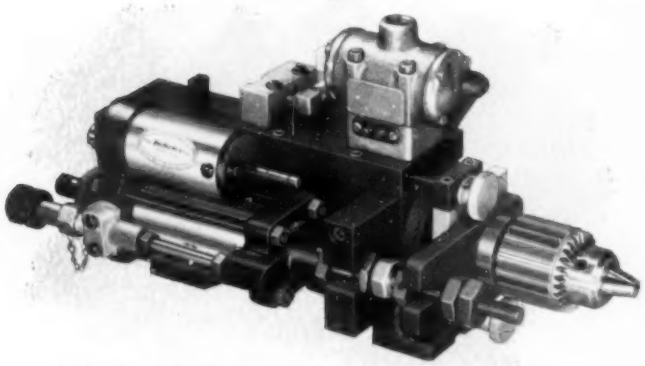
ACE... the Company built upon Rotary International's famous "FOUR-WAY-TEST"

CHEAPEST WAY YET TO DRILL HOLES

*New Air-powered Bellows-Locke Drill Head Sells for only $95.00**

Not much bigger than a carton of cigarettes, the Bellows-Locke Model 22A Drill Head is the low cost answer for many machining operations in the softer metals, plastics and wood. Drill capacity in mild steel from No. 80 to 3/16" diameter drill. 2" stroke. Thrust two times air line pressure. Adjustable positive stop. Can be controlled by any standard four way air valve. Available also (at extra cost) with a built-in Bellows Electroaire Valve and hydraulic feed control.

**As illustrated less chuck and pulley.*



Model 22A Drill Head with optional "Hydro-Check" and "Electroaire" Valve Assembly

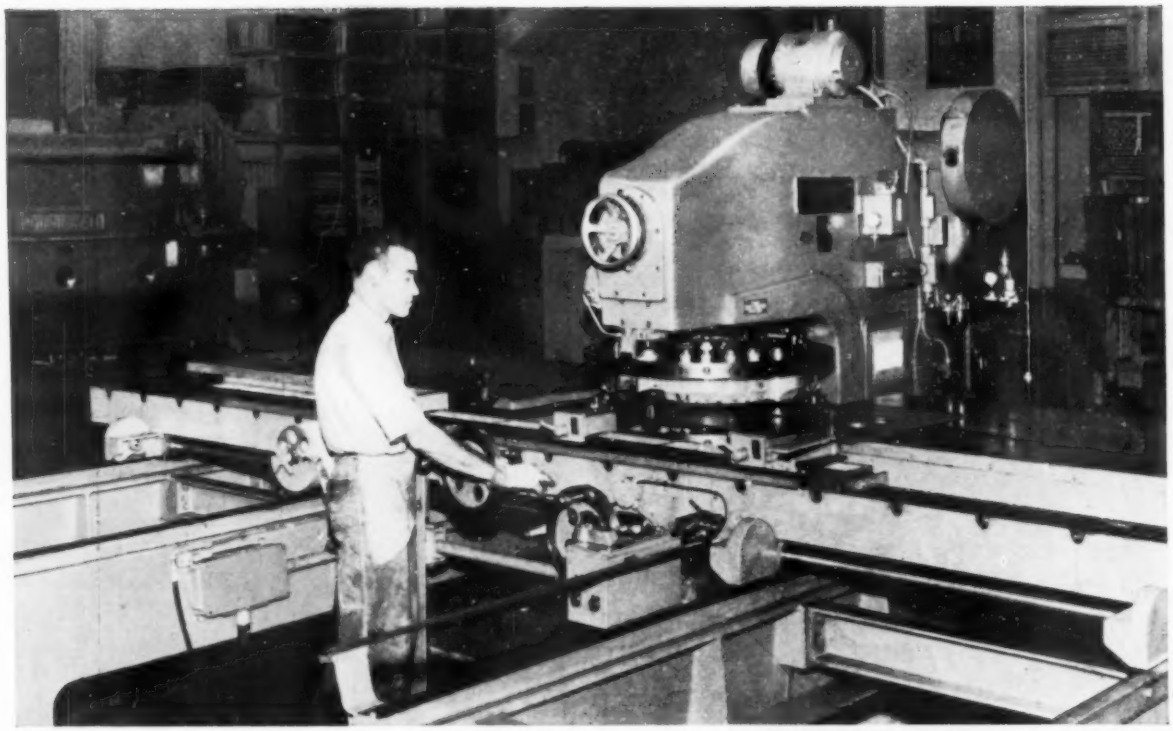
Write for Bulletin BL-22. Address The Bellows Co., Akron 9, Ohio, Dept. TE 1158. In Canada: Bellows Pneumatic Devices of Canada, Ltd., Toronto 18.

1196-B

The Bellows Co.

DIVISION OF INTERNATIONAL BASIC ECONOMY CORPORATION

AKRON 9, OHIO



One WIEDEMANN *Saves Over* $27,000 *a Year for* Reliance Electric

. . . and equally startling savings of from 60% to 90% are reported by users of Wiedemann Turret Punch Presses throughout industry.

With the Wiedemann Method, parts are completely pierced as needed—costly inventory is reduced. Layout, nibbling, drilling and other hand operations are eliminated. Engineering time is minimized, and changes can be made at low cost.

If you are producing openings of any size or shape in sheet metal or plate, it will pay you to get the facts about the Wiedemann Method.

Send for the full story on how this Wiedemann paid for itself in less than two years at Reliance Electric, and a copy of Bulletin 301.

Here's what Reliance Electric & Engineering Co., Cleveland saves on producing control panels for electronic and magnetic systems:

57% in direct labor on "Control Panel" production.

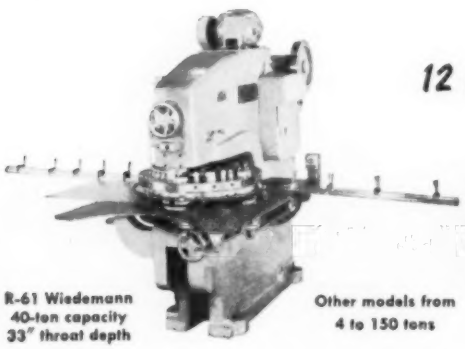
78% in direct labor on "Operator Panel" production.

26% in cost of parts previously purchased.

1008 hours per year of engineering time spent specifying and modifying stock panels.

276 hours a year in recording inventories and added rate setting.

SIMILAR SAVINGS CAN BE YOURS



R-61 Wiedemann 40-ton capacity 33" throat depth

Other models from 4 to 150 tons

12 to 32 Punches and Dies Ready for Use

WIEDEMANN MACHINE COMPANY

TURRET PUNCH PRESSES

DEPT. TE-11 • GULPH ROAD • KING OF PRUSSIA, PA.

For High Production, Precision Reaming . . . consider STANDARD'S Patented Carbide Tipped Expansion Reamer!

ACCURACY . . . Uniform expansion of all cutting edges. No high or low lands after expansion.

ECONOMICAL . . . Saves money . . . expansion feature offsets wear. Saves Time . . . no regrinding after expanding reamer back to size.

RIGIDITY . . . of conventional reamer is maintained . . . tool body is solid not split.

The STANDARD Distributor in your area stocks a complete line of rotary metal cutting tools.

Quality Tools Since 1881

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Why it makes sense to upgrade your metal-cutting band saws now!

This is the best time to replace your old sawing machines because:

1. Faster Cutting Rates

Fifteen years of progress in the last five—that's what DoALL band machining now offers you! For example, DoALL's Demon® HSS Blades on new DoALL machines cut 10 times faster—and last 30 times longer than any carbon blade.

The reason: DoALL's new Contour-matics® are built far more rugged to attain greater accuracy than ever before. They employ coolant and hydraulic work feed.

The result: enormous savings in production time and labor in your shop—an entirely new concept in metalworking undreamed of with the early Model ML, which uses only carbon blades.

2. Old Machines Now Worth More

There's more value in your old DoALL now than there ever will be. In numerous cases the current market price of the obsolete Model ML equals or exceeds its original cost. Rather than give up the "old faithful," many users have found other uses for it in their own plants—for the scope and application of band saw machining has expanded greatly every year.

3. Easier Terms

Long-term purchase contracts are available for all DoALL machine tools.

A lease program, originated by DoALL, is available for those who want to take advantage of cost-saving DoALL equipment without capital expenditure.

4. Lower Costs

"Tooling for competition" requires a frank appraisal of your sawing costs. **Let us demonstrate the new performance of DoALL band machining.**

5. Productive Maintenance

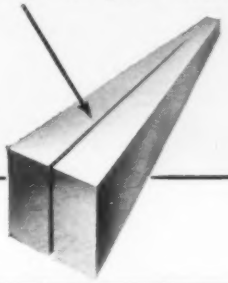
Productive maintenance is your assurance of continuous profitable performance on all DoALL machines. It's a free service to DoALL users. Ask your local DoALL representative.

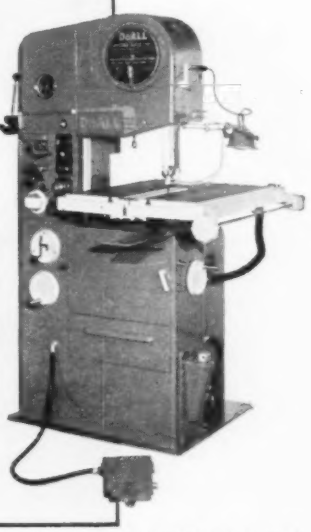
B-54

COMPARE...

1958 MODEL 16-3 GIVES YOU...

592% faster sawing on 1015 mild steel—10.1 sq. in. per min.!

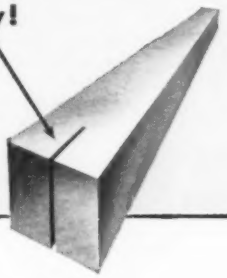




Heavy-duty Model 16-3 with coolant and hydraulic work feed, designed for Demon HSS Blade.

OBSOLETE MODEL ML GIVES YOU...

a cutting rate of only 1.7 sq. in. per min. —terrific in its day but unprofitably slow today!



Model ML, designed for carbon blade only.

THIS IS A TYPICAL DoALL STORE

The DoALL Company, Des Plaines, Illinois

Top Tooling is a 3-way responsibility of a 3-Man Team: (1) Your Tool Engineer—who knows your customer's requirements and the job schedule. (2) Your machine operator—who knows the ability and limitations of the machine, and (3) Your Kennametal Carbide Engineer—who knows which carbides to use and how to apply them.

It takes this 3-Man Team to modernize TOOLING for PROFITS

Leading tool engineers agree that the metalworking industry has been losing thousands of dollars annually through improper tools and techniques. But today's business climate dictates a good hard look at loose production practices . . . large tool inventories, costly regrinding, less-than-possible output! It's time to TOP TOOL, which means to get the *right tool* on every job—on *every machine* in your line.

Here's how your KENNAMETAL* CARBIDE ENGINEER can help you Tool for Profits:

1 With Kennametal tooling service

Helping you choose and apply the tools that will machine every job at a profit is the Number 1 assignment of your Kennametal Carbide Engineer. Your knowledge of the shop and job requirements, plus his thorough knowledge of Kennametal Tooling, give you the Top Tooling for increased profits.

2 With the right grade for every job

Once a study has determined the best tooling for your operations, the comprehensive Kennametal line provides a performance-proved grade to meet the specific needs of every job.

General purpose needs can be satisfied from Kennametal Group I grades which were recently expanded by the addition of grades K4H and K2S.

By moving these grades, previously classed as "premium," into the General Purpose Group, Kennametal now provides a total of seven economy-priced grades suitable for a broad range of jobs —and has opened the door to further savings by reducing inventory requirements.

For the ultimate in performance on specific jobs, Group II provides a grade selection tailored for today's high alloy materials, closer tolerances, higher cutting speeds, and specialized operations.

3 With the right tool for every operation

Kennametal offers you the world's most complete line of brazed and clamped-insert type tools . . . spearheaded by the Kendex† line with more than 50 standardized styles plus many adaptations for special needs.

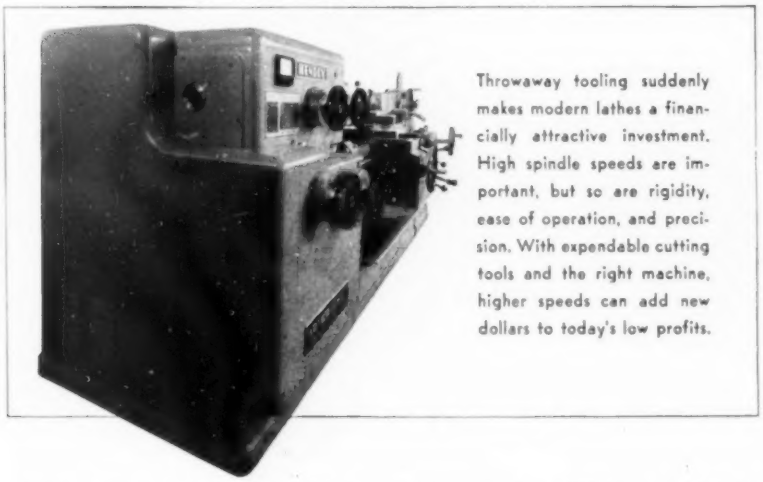
Let your Kennametal Carbide Engineer work with you to get the best tooling on your machines to squeeze more profit from every job today . . . and help you get set for stiffer competition tomorrow. Call him now, or write KENNAMETAL INC., *Latrobe, Pennsylvania.* 3176

*Trademark. †Trademark, U. S. Patent 2,848,789

INDUSTRY AND
KENNAMETAL
. . . Partners in Progress

Barber-Colman's new 36-speed lathe

gives you the three things you need to profit from throwaway tooling!



Throwaway tooling suddenly makes modern lathes a financially attractive investment. High spindle speeds are important, but so are rigidity, ease of operation, and precision. With expendable cutting tools and the right machine, higher speeds can add new dollars to today's low profits.

The biggest victory for carbides in 20 years is throwaway insert tooling!

And now is the time to invest in a new Barber-Colman 36-speed lathe . . . which combines precision, high speed, and ease of operation . . . to take advantage of the new savings made possible by these *expendable* cutting tools.

Speeds up to 2000 rpm are available for faster cutting — not at yesterday's rates calculated to prolong tool life — but at today's and tomorrow's rates designed to give economical tool life. You might spend more for carbide, but other savings make a big difference in the value added to the piecepart.

Rigidity where you need it

Negative-rake throwaways require power and rigidity. And here's where many old machines fail. Barber-Colman's carriage, cross slide, tailstock, and spindle are designed for heavy-duty, accurate work. Look at the depth of the apron which takes the thrust load from the tool. The carriage has a wide 30" span over the ways and guides on the front V-way right under the compound. The tailstock weighs over 400 lb, and two heavy clamps hold it rigidly even when cutting workpieces of maximum size.

Controls for busy operators

But, why use indexable, quick-change tools on lathes which waste hours per day because they're difficult to set up and operate? All controls on the "Barber-Colman" are human engineered to save time on high-production or short-run jobs. Only two dial-type, quick-reset handwheels mechanically actuate all 36 speed changes. The drive clutch can be operated from the apron *or* headstock. Engagement and direction of longitudinal-feed and cross-feed actuation are controlled from the apron, which also provides a thread-chasing dial and handle for engaging the half nuts.

PROFIT POINT — TURNING

No vibration from spindle

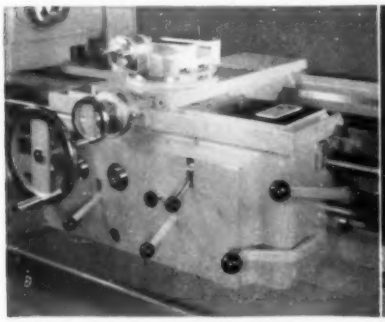
Speed, rigidity, and ease of operation are only part of what's needed for tomorrow's faster machining. Precision is a "must"— that's why Barber-Colman provides a *balanced*, accurately ground spindle supported at both ends and in the middle by *three sets* of precision tapered roller bearings. An automatic spindle bearing adapter gives a constant preload at all spindle speeds. You can do better work with precision inserts because there is no spindle vibration — use your lathe for both toolroom and production turning.

See a demonstration

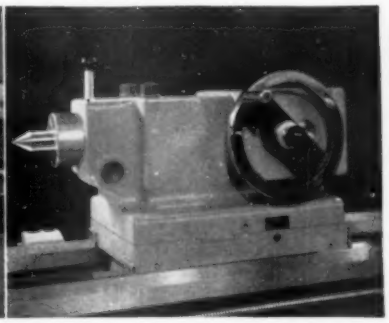
Before you buy a new lathe, see this one operate! Your Barber-Colman representative or dealer can arrange a demonstration either in his showroom or in Rockford.

Write for more information

New 16-page catalog will show you how the new Barber-Colman 36-speed lathe can pay for itself quickly as a replacement for an old lathe. It describes and illustrates the full line of threading features you want for toolroom and shop work. Write for a copy today.



Heavy-duty apron provides maximum rigidity and ease of operation. Carriage rides on front V-way, front flat-way and rear flat-way.



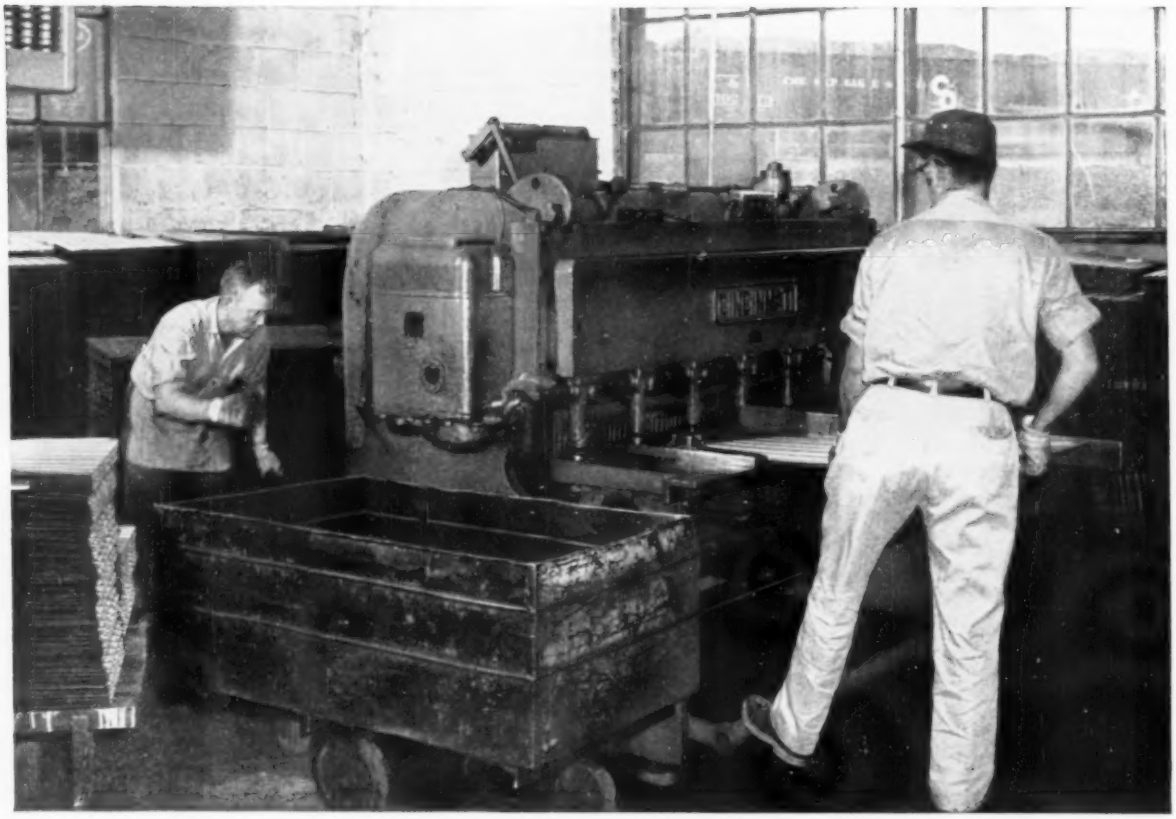
Heavy-duty tailstock weighs over 400 lb, yet can be positioned quickly and easily with one hand due to special antifriction mounting.

Barber-Colman Company
113 Loomis Street, Rockford, Illinois

Don't expect a day's work for a day's pay on yesterday's machine tools

BARBER COLMAN

PRECISION LATHES



PRODUCTION: 10,000,000 cuts
MAINTENANCE COST: $896.00

This Cincinnati® Shear has been in constant service for ten years, cutting 18-gauge corrugated sheet, 1010 draw quality, for a prominent heating equipment manufacturer at an average rate of 4000 cuts a day. That adds up to more than a million strokes per year — or 10,000,000 strokes in ten years.

Accuracy has always been excellent. The machine has been "down" *only for blade changes.* Special blades are used in this operation, to eliminate distortion of the corrugations.

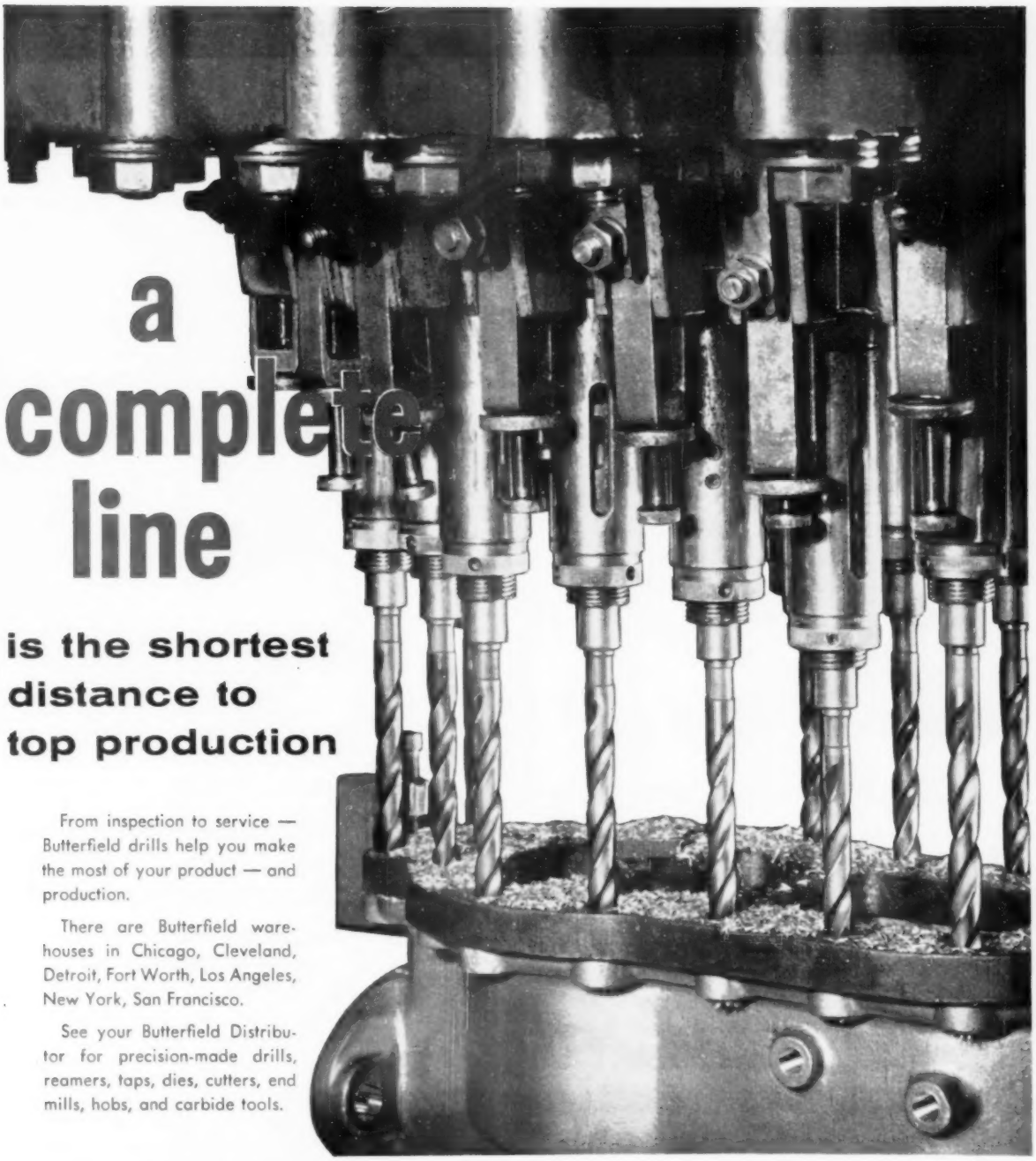
Cost of machine maintenance, including blade resharpening, has been $896.00 for the entire ten years. "This," says their production manager, "to my way of thinking, is very good performance." We agree. Yet this is not exceptional. Every Cincinnati® Shear is built to provide this kind of dependability and low maintenance, and we have hundreds of case histories to prove the point.

Specify Cincinnati® for all your shear requirements. Write Department E for Catalog S-7R.

Shapers / Shears / Press Brakes

THE CINCINNATI SHAPER CO.

Cincinnati 11, Ohio, U.S.A.



a complete line

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From inspection to service — Butterfield drills help you make the most of your product — and production.

There are Butterfield warehouses in Chicago, Cleveland, Detroit, Fort Worth, Los Angeles, New York, San Francisco.

See your Butterfield Distributor for precision-made drills, reamers, taps, dies, cutters, end mills, hobs, and carbide tools.

BUTTERFIELD

. . . the cutting tools that make the most of your product

BUTTERFIELD DIVISION, UNION TWIST DRILL COMPANY, DERBY LINE, VERMONT

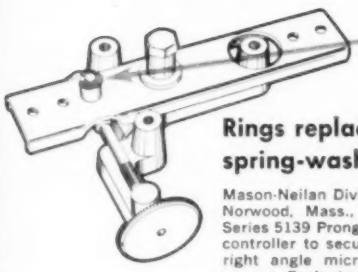
Waldes Truarc Prong-Lock Ring Eliminates Springs, Washers, Takes Up End-Play

WALDES TRUARC
SERIES 5139 RETAINING RING*

application: external for shafts
range: 3/32" through 7/16"

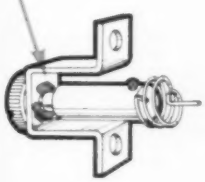
*U. S. Pat. No. 2,755,698

After radial application, the Waldes Truarc Prong-Lock retaining ring locks and holds securely in its groove by means of two prongs. Because of its resistance to radial displacement, the ring may be used as a shoulder for rotating parts. Thrust-load capacity ranges from 80 to 700 lbs. for sizes from 3/32" to 7/16". Bowed construction provides end-play take-up, often eliminating springs, washers and accessory devices.



Rings replace cotter pins, spring-washers; save $68.00/M

Mason-Neilan Division of Worthington Corp., Norwood, Mass., uses two Waldes Truarc Series 5139 Prong-Lock rings on its pressure controller to secure pivots through which a right angle micrometer adjustment screw passes. Each ring replaces hairpin-type cotter pin and bowed washer... provides necessary tension to prevent adjustment screw from shifting. Manufacturing costs were reduced by $68 per 1,000 units.



Ring replaces locknut, eases control calibration

On a differential pressure control mechanism, Taylor Instrument Companies, Rochester, N. Y., replaced a locknut and eliminated a costly threading operation with a series 5139 Prong-Lock ring. Also eliminated is the loosening and tightening of the locknut before and after each calibration setting. Spring action of the ring securely holds the calibration setting.

Whatever you make, there's a Waldes Truarc Ring designed to save you material, machining and labor costs, and to improve the functioning of your product.

In Truarc, you get:

Statistically Controlled Quality from engineering and raw materials to the finished product. Every step in manufacture watched and checked in Waldes' own modern plant.

Complete Selection: 36 functionally different types. As many as 97 standard sizes within a ring type. 5 metal specifications and 14 different finishes. All types available quickly from leading OEM distributors in 90 stocking points throughout the U. S. and Canada.

Field Engineering Service: More than 30 engineering-minded factory representatives and 700 field men are at your call.

Design and Engineering Service not only helps you select the proper type of ring for your purpose, but also helps you use it most efficiently. Send us your blueprints today . . . let our Truarc engineers help you solve design, assembly and production problems . . . without obligation.

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RETAINING RINGS

WALDES KOHINOOR, INC., LONG ISLAND CITY 1, N. Y.

Waldes Kohinoor, Inc., Long Island City 1, N. Y.

Please send me additional information and engineering data for the Truarc Prong-Lock Ring, Series 5139.

Name_____

Title_____

Company_____

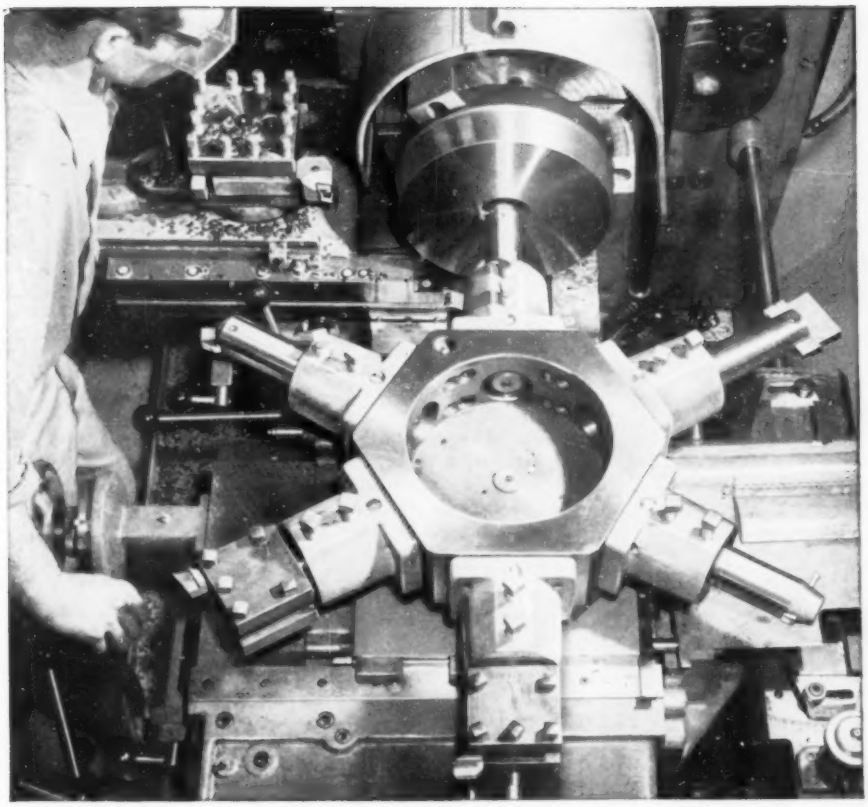
Business Address_____

City_____ Zone____ State_____

TE-110

Consult the Yellow Pages of your Telephone Directory for name of Local Truarc Factory Representative and Authorized Distributor. Look under "Retaining Rings" or "Rings, Retaining."

TO OBTAIN FURTHER INFORMATION ABOUT ADVERTISERS, TRADE LITERATURE OR TOOLS OF TODAY APPEARING IN THIS ISSUE OF THE TOOL ENGINEER, USE THE HANDY READERS SERVICE CARD ON PAGE 175.



Expert setup gets more work per chucking

How manufacturer uses C/F turret lathe to produce variety of chuck bodies with only one tool change

To do the job, the manufacturer selected a Gisholt 1L Saddle Type Turret Lathe with a cross-feeding hexagon turret. A 15" 3-jaw air chuck holds down chucking time. One set of adjustable serrated jaw bases handles the different workpiece sizes for first machining operations. A quick-indexing square turret on the cross slide carries turning, facing and chamfering tools, which work simultaneously with tools on the hexagon turret.

Three stub boring bars on the hex turret bore, counterbore, recess and back face. Because size is set with the cross-feeding turret, these same boring bars are used on different part sizes. Also on the hexagon turret are 2 box-type tool posts for facing, boring or recessing—used for different size workpieces because of the cross-feeding feature. A threading attachment lets the manufacturer thread the hubs, and a taper attachment handles up to 8 inches taper per foot when required.

The sixth tool on the hex turret, a spade cutter, is used for final sizing and is the only special tool changed for each job.

Simple, low-cost tooling combined with the cross-feeding hexagon turret offers maximum efficiency in handling various sizes of similar parts. The rugged Gisholt MASTERLINE Saddle Type Turret Lathes have the speeds, feeds and power to complete the work in the least amount of time. Call your Gisholt Representative today, or write Gisholt for literature.

MASTERLINE GISHOLT SINCE 1887 GISHOLT

GISHOLT MACHINE COMPANY

Madison 10, Wisconsin, U.S.A.

WRITE TODAY for complete set of Gisholt MASTERLINE Saddle Type Turret Lathe Bulletins.

TURRET LATHES • AUTOMATIC LATHES • SUPERFINISHERS • BALANCERS • PACKAGING MACHINES • MOLDED FIBERGLAS PLASTICS

Quality... Service... Dependability...

ACME
STANDARD AND A.S.A. BUSHINGS...

are designed and engineered for you, the ultimate user, with all the mystical qualities Aladdin found in his lamp.

A rub here, a polish there produces over 30,000 standard and A.S.A. drill jig bushings within tolerances of .0003 of an inch not to mention the genie-fast and dependable nation-wide distribution system which over 35 years of Acme service has built.

If you want the very best in quality, service, and dependability, *only* Acme can supply it.

For Acme Dowel Pin information or free pocket size selector, check coupon and mail today.

ACME INDUSTRIAL COMPANY
208 North Laflin Street
Chicago 7, Illinois

ACME INDUSTRIAL COMPANY
208 N. Laflin St., Chicago 7, Illinois

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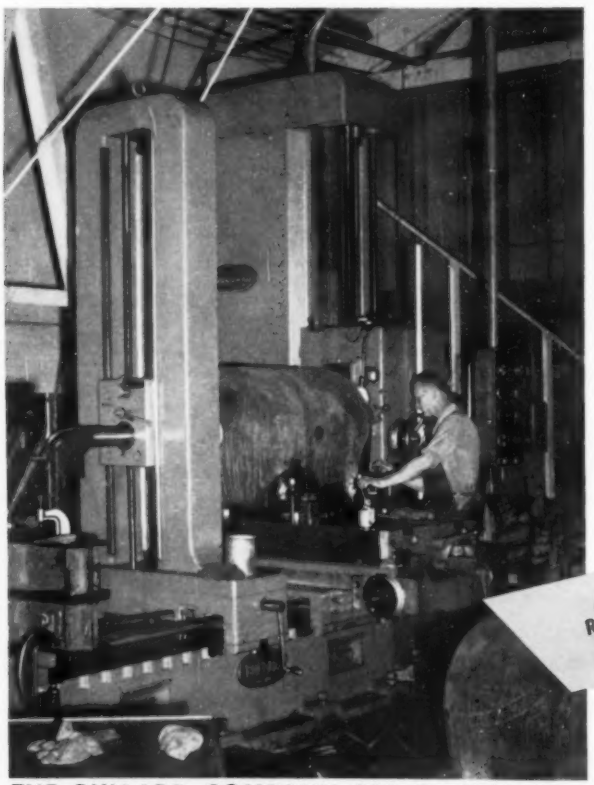
"To meet Today's and Tomorrow's Complex Machining Problems

we bought a . . . BULLARD H.B.M. model 75"

This statement by Mr. Reed Clark, General Manager, C. & H. Machine and Engineering Company, Berkeley, California summarizes, after thoroughly investigating and comparing competitive machines, their conclusion.



If you are planning to purchase a horizontal boring machine, we invite you to compare, feature for feature, the Bullard H.B.M., Model 75 with other machines in its field. You will discover that — "To Cut Costs When Cutting Metal — Buy Bullard" — is sound advice.

A call to your Bullard Sales Representative or Distributor will bring you the complete story.

BULLARD

THE BULLARD COMPANY 286 Canfield Ave. Bridgeport 9, Connecticut

ASTE COLLECTED PAPERS, 1958

Mail Your Order Today

ASTE COLLECTED PAPERS, VOL. 58, BOOK II will be ready for distribution on October 1, 1958. This set embraces papers to be presented at the 26th Semiannual Convention of the American Society of Tool Engineers in Los Angeles, California, September 29—October 3, 1958.
The set includes all papers for which manuscripts were received in time for preprinting. A complete list of the individual papers scheduled to be presented is given below:

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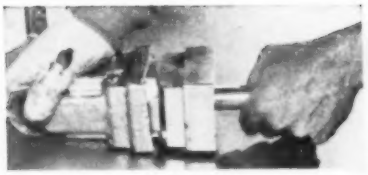

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Eliminate Stock Pushers...
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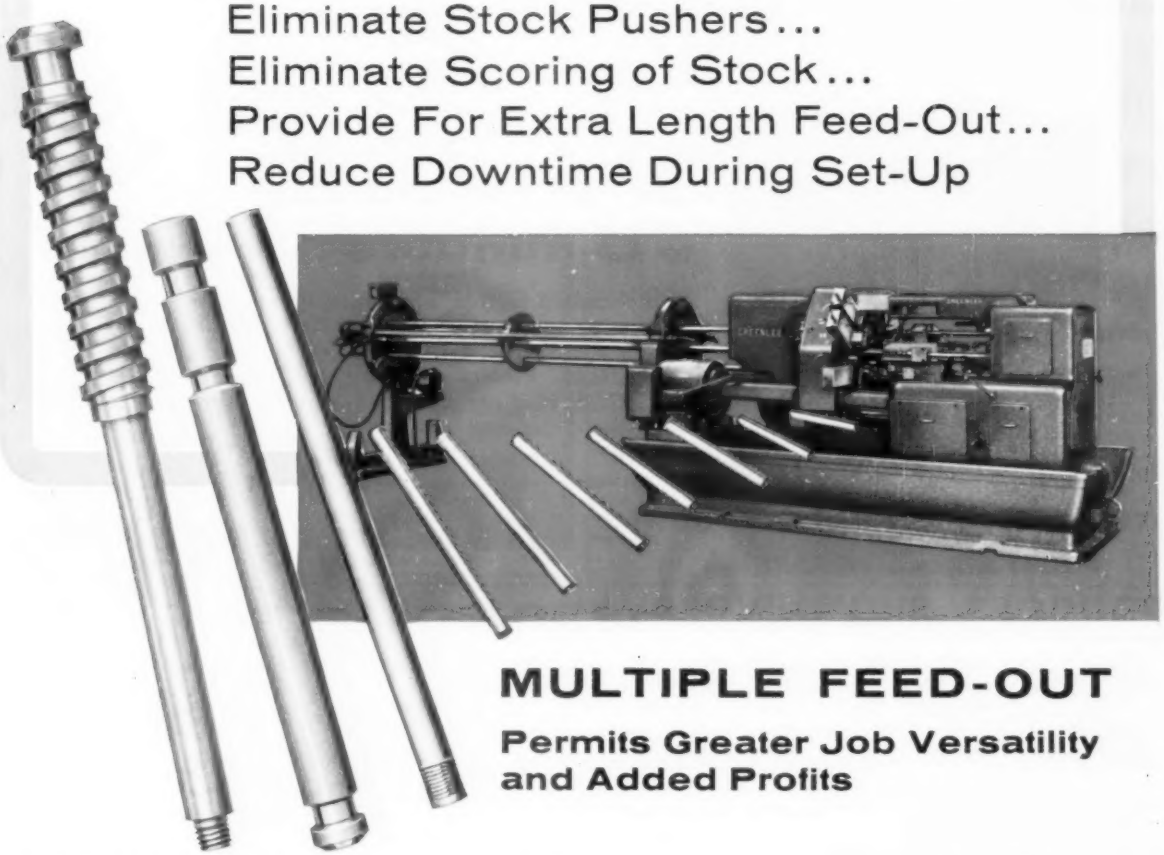

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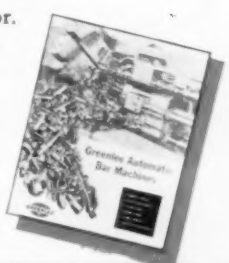
Greenlee Air-Feed Automatics give you a competitive edge. The multiple feed-out arrangement offers a distinct profit advantage in machining many types of parts. Threads and oil grooves may be rolled on any portion of long shafts. Finish forming may be done on either end. See your Greenlee Distributor. He'll show you how Greenlee Air-Feed Automatics will pay off for you.



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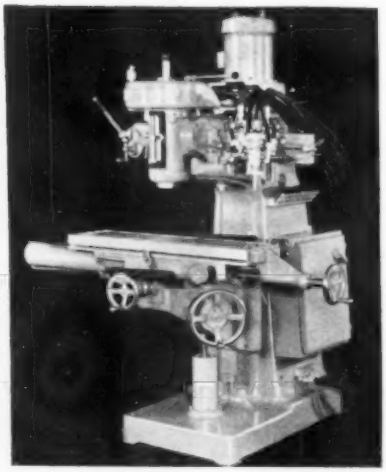
GORTON MACHINE TOOLS,

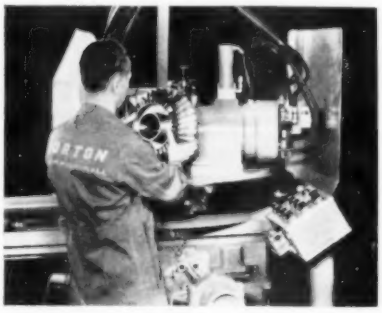
both standard and custom-designed, are today *paying for themselves in record time. Here are just three typical examples:



from **8 Hours** per piece to **5 Minutes** per piece

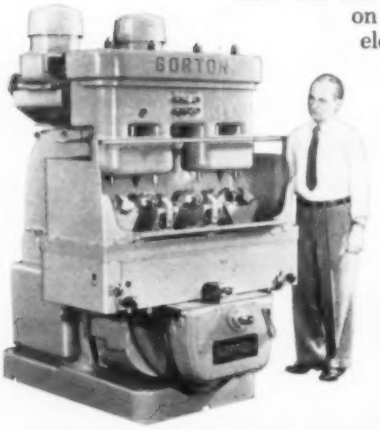
This standard Gorton Trace-Master Hydraulic Duplicator was purchased to profile a complex part from a simple master. Previous cost of this operation was $102.40. Present cost with this Gorton machine is $1.07. Saving per piece is $101.33.

*Cost figures were arrived at by using $2.80 per hour for operator's time and $10.00 per hour, Machine rate.



cost saving per piece . . . **$1,139.20**

This Gorton Horizontal Mill with special holding fixture, tooling, hydraulics, etc., was purchased to machine thirty-five impeller blades from the solid, involving compound curvatures, thicknesses and depths. Former production time was one piece in 100 hours. Present time on this new machine is one piece in eleven hours. Machine was paid for after machining 22 pieces.



$50,000 machine pays for itself in **41 Weeks**

This Gorton 4-spindle "Automatic Cycle" Duplicator was purchased to mill out recesses in a round steel part. Original production time on a manually operated single spindle duplicator was 60 pieces per hour. Present production on this new machine is 204 pieces per hour. Cost saving is 71%.

Cost reduction and improved accuracy are important to you today. We shall be glad to analyze your needs and make specific recommendations on request.

Your letterhead inquiry will receive prompt attention.

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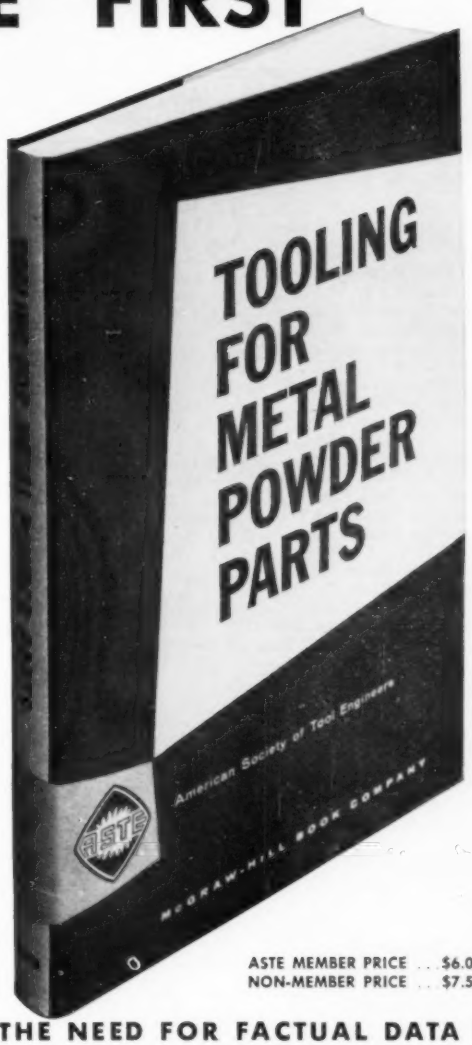
A REFERENCE manual . . . an IDEA stimulator . . . a COMPARISON guide — by GEORGE H. DeGROAT, Associate Editor, *American Machinist*.



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Index of THE TOOL ENGINEER Advertisers

November 1958

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The spirally slotted outer sleeve does the trick. Tension spring action lets you select the exact tension for satisfactory feeding. Now, with Balas Adjustable Tension Master Pushers you can get as much speed and accuracy from your automatics as they are capable of — reduce down-time and get better quality products.

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Automobile steering gear ball-race screws in three stages of processing: blanks, rough-ground, and finish-ground.

Ex-Cell-O Style 33 Thread Grinder equipped to automatically grind steering gear ball-race screws.

XLO EX-CELL-O FOR PRECISION

57-73

Automatically!

These automobile steering gear ball-race screws are rough-ground from the solid on an Ex-Cell-O Thread Grinder. This operation was formerly done by thread hobbing or milling. The screws then go into the machine illustrated, an Ex-Cell-O Style 33 Thread Grinder, equipped for automation. It self-loads, locates, finish-grinds, and ejects steering gear screws. What's more, when desired, the wheel can be automatically dressed after completing a predetermined production. It increases hourly per-unit output over manually operated machines while actually decreasing the number of rejects. A double saving.

Ex-Cell-O Precision Thread Grinders come in a wide range of models—some best suited for toolrooms and short runs, others designed for fully automatic, high volume output. In all, there are five models adaptable to any production requirement.

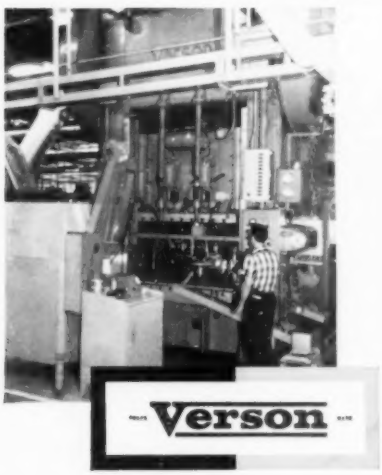
Why not find out today how these Ex-Cell-O Precision Thread Grinders may be able to reduce your per-unit costs? For full information, just call your nearby Ex-Cell-O Representative.

EX-CELL-O CORPORATION *Machinery Division*

DETROIT 32, MICHIGAN

MANUFACTURERS OF PRECISION MACHINE TOOLS • GRINDING AND BORING SPINDLES • CUTTING TOOLS • TORQUE ACTUATORS • RAILROAD PINS AND BUSHINGS • DRILL JIG BUSHINGS • AIRCRAFT AND MISCELLANEOUS PRODUCTION PARTS • DAIRY EQUIPMENT

Are you "whittling" out metal parts that could be IMPACT MACHINED at a fraction of the cost?



If you manufacture machined parts by cutting away sections of a chunk of steel until only a piece of the required size and shape remains, you may be missing an opportunity to substantially reduce your manufacturing costs.

The opportunity is Impact Machining.

Impact Machining is the practical application of the principles of cold extrusion to the manufacture of a wide variety of piece parts that formerly had to be made by metal removal processes or hot forged. In this process, suitably tooled presses cold flow metal into the required shape with little or no conventional machining . . . little or no scrap.

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